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THE

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1901 Edition

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ELECTRIC v. STEAM RAILWAYS.

AT the meeting of the City and South London Railway Company last Friday, Mr. C. Grey Mott stated that the working expenses of our great steam railways for the first half of 1901 would be found to be in the neighbourhood of 70 per cent. of the receipts. He proceeded, with justified enthusiasm, to compare that figure with the total working expenses of the electric underground railway of which he is practically the father. He was able to report that the continued efforts which have been made to bring this item (which was 79 per cent. when the line started) down to a minimum, have been still further successful during this half-year, so that the total figure is now only 52·36 per cent. as against 59·36 per cent. in the corresponding period of 1900. But in making this comparison, it is necessary to add that the City and South London has a heavy burden to bear which steam railways have not—we refer, of course, to the lifts by which passengers are conveyed from and to the surface. The figure of 52·36 per cent. is reduced to 41·25 per cent., if we deduct the cost of operating these lifts, so as to make the comparison more just. We then find the figures are 70 per cent. for steam, and 41¼ per cent. for electricity. Such figures as these are ample testimony to the economic benefits to be derived from the working of short railway lines by electric traction. It may seem hardly correct to compare a great trunk line railway with the short electric line, but at the same time the heavy capitalisation of the deep level line on account of its costly tunnelling construction has to be set down as its peculiar disadvantage. A more practical and even more interesting comparison of working expenses would have been made if those of the Central London had been plotted side by side with those of the City and South London—the one with its heavy American electric locomotives and the other with its light English ones, but both bearing the cost of lifts at stations.

The working expenses of the Waterloo and City electric line, on which there are no lifts, are 54·78 per cent. of the receipts for the past half-year.

The C. & S. L. dividend would have been larger this year but for the fact that no provision whatever has been made during the last 11 years for renewal of plant or depreciation funds. The directors should be urged to set this defect right as promptly as possible, even without waiting for the clearing off of the remainder of the £8,000 which represents the cost of renewals recently made, £5,000 of which is to be distributed over the next few half years. Apart from this feature of the concern, and its dead capital sunk under the Thames for the time being, the outlook is certainly improving for the world's pioneer underground electric line, and we trust that the hopes which have been held out regarding the Islington extension, which is to be completed in September, will turn out to be justified. For its patient perseverance the company deserves any good that may come to it, and we wish it

well. It is interesting to remark that when the line is opened from Clapham to Islington it will be longer than the Central London Railway. The comparative results under the new circumstances thus created, should be of even greater interest than any figures now available.

While referring to this matter, we may add that the Parliamentary Committee which has been inquiring into the whole subject of the London underground proposals has issued its report. We publish it in our other columns this week, and believe that it will be found of considerable interest to our readers.

Wireless Telegraphy Experiments in America.

A number of interesting experiments in wireless telegraphy have been carried out since January, 1900, by the United States Weather Bureau, under the direction of the chief of the Bureau, Prof. Moore. These experiments, judging from an account given by Mr. R. A. Fessenden in the *Electrical World and Engineer*, of New York, appear to have resulted in many improvements. Though in many respects they have been running on parallel lines with Marconi's most recently published experiments, yet in a few points they have led to considerable advances, even on Marconi's best results. Mr. Fessenden's description is hampered by the existence of unpublished patents, and consequently we have to take many of his statements on trust, as he does not describe the means by which some of his most remarkable results have been obtained. Like Marconi, the experimenters at the United States Weather Bureau have discovered the importance of reducing the damping effect of the radiator, but they have adopted a somewhat different method of securing this result. The formula for the logarithmic decrement of the amplitude of the electric waves radiated, contains the power $\frac{R}{L}$, hence the decrement can be reduced by decreasing R or increasing L. Marconi has adopted the latter method, but the Weather Bureau has adopted the former. The Weather Bureau's method has this advantage, that by decreasing the numerator they keep the amount of energy radiated the same, and do not change the period, while they make the logarithmic decrement just as small as can be obtained by increasing the inductance, whereas by increasing the denominator the period is decreased, and also the total amount of energy radiated per oscillation.

Mr. Marconi makes the secondary of his coil equal to the height of his sending conductor; Mr. Fessenden, on the other hand, makes it equal to twice the height of the sending conductor. Two explanations of this difference are offered; first, that Mr. Marconi uses the secondary wound in such a manner that the wire really has a longer period than if it were straight; second, that he is really working with the first overtone. There may be some other cause not at present known, but all Mr. Fessenden's experiments seem to show that the wave length is really four times the length of the vertical conductor, and not twice. Mr. Fessenden's experiments show plainly that Mr. Marconi's remarks on Prof. Slaby's work are justified, since he also found that much better results were got by Marconi methods.

Some interesting experiments were made by the Weather Bureau to determine what length of spark gave the maximum radiation. An electrical device was invented, which, on being applied directly to the sending wire, measured directly the amount of energy radiated. A curve was then plotted, showing the relation between spark length and energy radiated, and it was found that the curve gave a sharp bend with a spark about 1 in. in length, and no further increase of radiation could be obtained by lengthening the spark. All sorts of induction coils and spark gaps were tried without effect, but at length a solution was found, by means of which the amount of energy radiated was increased 16 times. Mr. Fessenden tantalises us by withholding the description of this wonderful device, hampered again, no doubt, by his unpublished patents. Messages were transmitted over 50 miles by this radiator, without the adventitious aid of transformers, inductive devices, &c., recently adopted by Marconi.

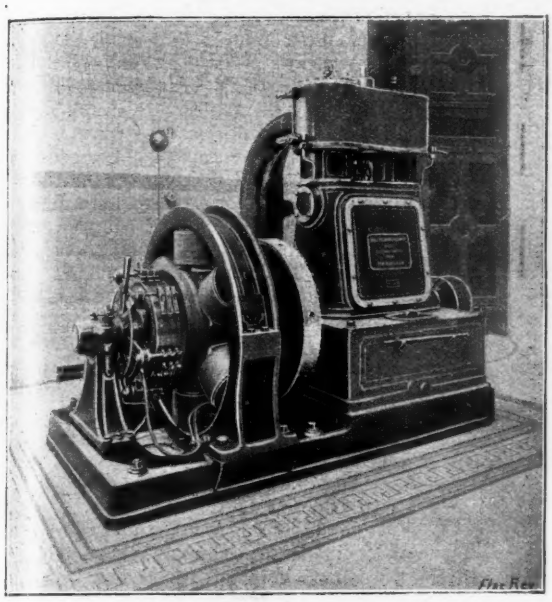
Another surprising discovery to be found in the Weather Bureau patents (when they are published) is a means by which a wire, 1 metre in height, can be made to radiate as much energy and of the same period as a wire 100 metres high. It has been found necessary to differentiate in form between the receiving and sending conductors by giving the receiving conductor more inductance and less capacity than the sending conductor. The Weather Bureau, as the result of their experience, consider Marconi's system of sending non-interfering messages by means of syntony to be in practice defective, because, by means of an electric device analogous to the siren, electric tones of rapidly varying pitch can be produced which would render unintelligible all syntonised messages in its neighbourhood. This has always appeared to us to be a serious objection to syntony as a means of transmitting non-interfering messages. The American experimenters have discovered several other methods of selective signalling not open to the above objection, but for any information as to the nature of these devices we have still to wait. Considering the sensational nature of the forecast given by Mr. Fessenden, the publication of the Weather Bureau patents will be awaited with great interest by all wireless telegraphists.

Fatality.—An inquest was held at Greenwich on Monday relative to the death of Peter Ewen Wimble, aged 24, an assistant switchman in the employ of the London Electric Supply Corporation, at Stowage Wharf, Deptford, who died in the Seamen's Hospital, Greenwich, on Friday from shock following burns caused by an electric current. Deceased's stepfather said that he saw him in the hospital. Deceased told him that he went into the transformer room at the works for a fuse tube, and on turning round he missed his footing and stumbled. In putting his right hand out to save himself he caught hold of a line fuse. Dr. West, house surgeon at the hospital, said that deceased was severely burnt about the body. He did not, however, at first think it would be a fatal case. Death was due to shock. He considered that the burns, which were not ordinary, were caused by an electric current. Herbert Wentworth, a fellow employé, proved seeing a flash in the transformer room and the deceased lying on the floor. His clothes were smouldering. William John Wilton, a switchman in the employ of the Corporation, said that on July 17th deceased, who was his assistant, and himself were engaged in making up test fuses, and witness sent him to get a spare fuse tube to replace one which he had broken. He had been gone about two minutes when witness heard a loud report. On going to where deceased was he found his clothes on fire. Deceased told him that he stumbled and caught hold of a live fuse. Replying to Mr. Owner, H.M. Inspector of Factories, witness said that about 10,000 volts were passing through the fuse in the transformer. Witness could not account for the deceased receiving his injuries unless he fell against the rack containing the live fuse and received the shock before he broke the tube. The rack was not in a very safe place, but witness had not heard complaints regarding it. If the transformers had been encased the accident would not have happened, but these could not have been protected because of the heat. Witness had never suggested any protection. Answering Mr. G. W. Partridge, chief engineer to the Corporation, witness said that he had never known transformers working at 10,000 volts to be encased. Deceased told him that he knew that the transformer was alive. Clement Johnson Barley, superintendent at the works, said at one time the transformers were protected, but they were not so now. The jury returned a verdict that the deceased died from shock following burns produced by an electric current.

LONDON UNITED TRAMWAYS.

(*Continued from page* 152.)

In the engine room are also located two lighting sets, each consisting of a two-crank tandem-compound high-speed vertical Belliss engine coupled to a 75-kw. compound-wound direct-current 500-volt. B.T.H. generator, running at a speed of 400 revolutions per minute. These provide

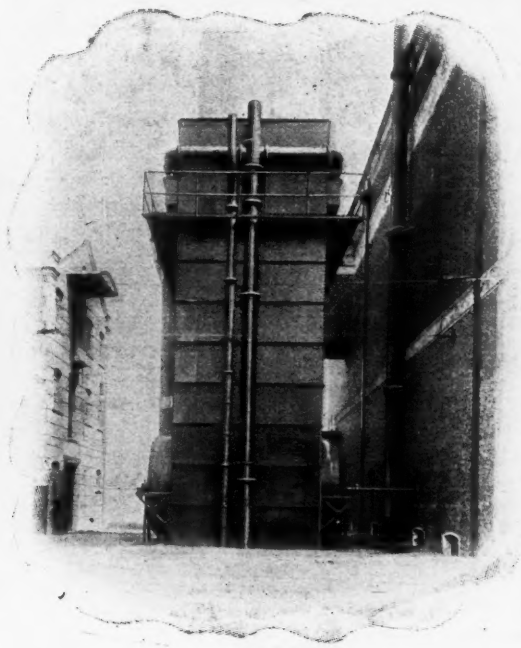


Bellis-B.T.H. Lighting Set.

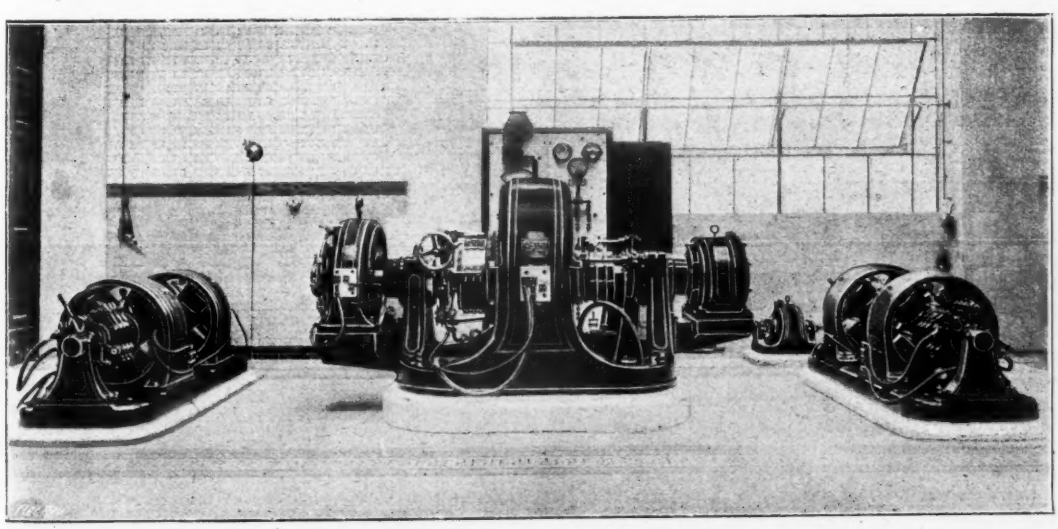
electric light for the offices, car sheds, and works generally, and also provide power for the various motors used in the machine shops, &c.

There are two 15-kw. boosters for use in connection with the rail return. These boosters are motor-driven, and run at a speed of about 1,000 revolutions per minute. The generator is designed and constructed as a series machine for proportional excitation, and, with a current of 300 amperes, the potential difference across the armature is 50 volts. The fields of the boosters are connected in circuit with the outgoing feeders, and the armatures to the track return and the negative bus bar, so that the amount of boosting is proportional to the amount of outgoing current. For further regulation a shunt-regulating rheostat is provided.

The engine room also contains one 250-kw. Westinghouse rotary converter, similar to those installed in the sub-stations. This will either be operated for transforming alternating current to direct current, so as to assist in supplying power to the lines in the vicinity of the power station, or it may be used to assist the three-phase generator —*i.e.*, it may be driven as a direct current motor, generating alternating current, which will be stepped up to 5,000 volts and then transmitted and transformed at the sub-stations. For operating the rotary converter as a three-phase generator in the manner indicated, a separate exciter is provided; this consists of a series generator driven by an induction motor connected to the three-phase side of the rotary. This arrangement provides a compensating field, and prevents variations in the speed of the converter from variations in the load. The transformers used in connection with this machine are placed in the engine room basement.



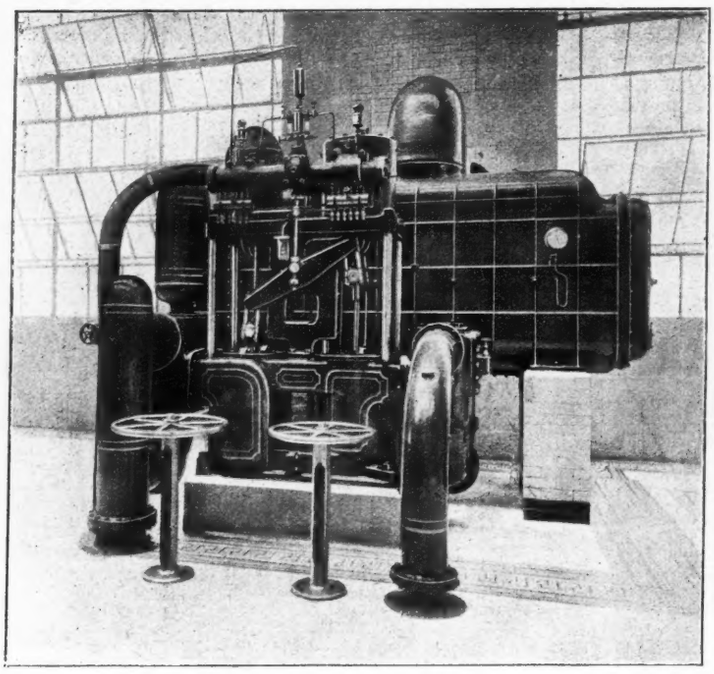
Cooling Tower.



Rotary Converter and Boosters in Power Station.

The condensing apparatus is located in the engine room, and consists of two Wheeler surface condensers, each containing 3,200 sq. ft. of cooling surface, and each provided with a separate combined air and circulating pump of the vertical cross-compound duplex-acting type, with steam cylinders 8 in. and 15 in. and air and water cylinders 20 in. diameter

and 15 in. stroke. The exhaust from the main engines may either be taken to the condensers or to the atmosphere, passing through an automatic exhaust valve. The condensers are so arranged that any one or more of the main or lighting engines can be connected to either condenser.



Condenser and Pumps.

Cooling towers are provided for condensation. These are of the Barnard twin type, arranged in three sections, covering a ground space of 40 ft. × 15 ft., and 38 ft. high, with a capacity for dealing with 6,000 H.P. The mats composing the cooling surface consist of galvanised iron wire netting, and a proper system for distributing the water over these mats is provided. Air propellers are provided for each section, operated at 160 revolutions per minute by an electromotor in the engine room, the shafts extending through the wall to the fans. The condensing apparatus is capable of maintaining a vacuum of 25 in. of mercury under all atmospheric conditions.

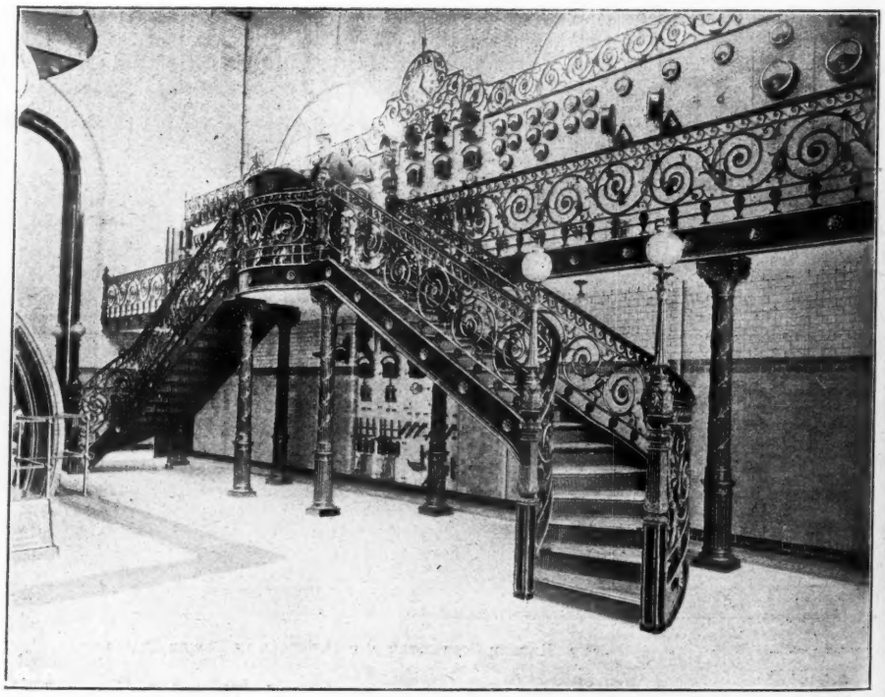
The basement under the engine room contains nearly the whole of the steam, exhaust, and water pipes, together with the hotwell, pumps, feed water filters, and feed water heater. The hotwell, to which the air pump discharge is taken, consists of a cylinder 48 in. in diameter by 96 in. long. The feed water is taken from this, and is pumped by two motor-driven triplex Wheeler pumps through the filters into the tanks above the boilers. The piping is so arranged that the feed water may be pumped from these tanks either through the feed water heater or through the economiser, through both, or direct to the boilers. The feed water heater, made by the Wheeler Condenser and Engineering Company, has a heating surface of 520 sq. ft., the exhaust from the lighting engines and the boiler feed pumps being available for heating the water.

The switchboard is erected at the south end of the engine room, upon an ornamental gallery 9 ft. from the floor level. It consists of white marble panels 7 ft. 6 in. high by 2 ft. wide, bolted to angle iron frames, there being 27 panels in all. The board extends practically the whole width of the room, one half being for the direct current panels and the other for the three-phase panels. The direct-current board consists of four railway generator panels, two booster panels, eight feeder panels, one Board of Trade panel, and one instrument panel. The high pressure three-phase board contains three generator panels, and eight feeder panels.

The switches and bus bars for the high pressure system are supported by joists in a closed chamber underneath the switchboard floor, the switches being of the oil break type, operated by levers on the switchboard.

In addition to this main switchboard, there is a lighting switchboard underneath the main gallery, consisting of two lighting and two power circuit panels, together with two panels for operating the rotary converter above described. The whole of the switch gear was supplied by the B.T.H. Co.

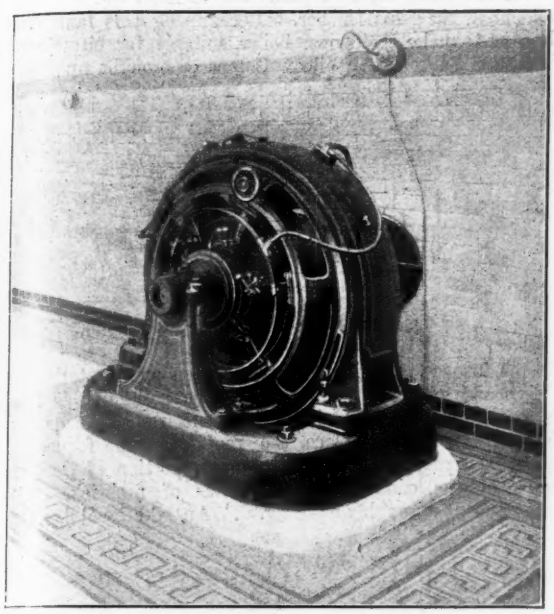
The chimney shaft presents some features of interest. Its total height above ground is 260 ft., with a diameter at the top of 10 ft. inside the firebrick lining. The upper portion (200 ft.) of this stack is built of steel plates in rings, securely lap-jointed and riveted together, and attached to a massive baseplate of cast-iron made in segments, the whole being held down to the masonry by steel bolts of large



Main Switchboard Gallery.

diameter, passing through the masonry to the surface of the concrete foundations hereinafter mentioned. The top is furnished with an ornamental cap of galvanised steel.

The chimney base below the steel stack has been worked out in red brick and Portland stone, to correspond with the

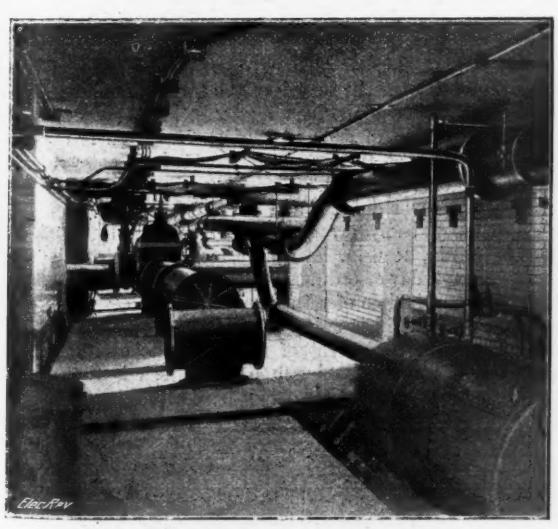


Motor Driving Fans in Cooling Tower.

power station. As the main flue, after leaving the economisers, passes to the smoke stack at a height of over 30 ft. above the ground, the space below the entrance of this flue is used as a store.

The chief point of interest in the smoke stack lies in its foundation. Borings were made at several points on the site, and water was met with at depths varying from 8 to 10 ft., according to the seasons, &c. The soil was found to consist of sand and ballast, with blue clay underlying at about 28 ft. below the surface, and while it was decided to carry the foundations down to the clay, the method to be adopted was not so readily arrived at.

The site most suitable for the stack, and now occupied by



Piping in Basement.

it, is at the north end of the boiler room, between it and a building used as a store, with only a few feet between the proposed concrete sub-structure and the footings of the two walls. It was feared that were a solid mass of concrete put down so near to these buildings, the necessary pumping operations might endanger the stability of the walls, and a simple concrete block was for this reason abandoned. Instead, a hollow rectangular structure of pitch pine was prepared at ground level, tied together in the strongest possible manner with bolts and straps, and provided with a cast-iron cutting edge. This shoe was filled up with cement concrete, and when this was well set the ground inside was removed, so that with the aid of the pumping operations the whole might gradually subside. A further layer of concrete was then filled in, and these operations were repeated until the blue clay was reached, when the whole of the lower portion was filled up solidly with concrete, so as to equally distribute the weight of the superstructure.

(To be continued.)

SMOKY FURNACES, AND HOW TO AVOID THEM.

By W. H. BOOTH.

(*Continued from page* 169.)

The introduction of fire doors—usually unprovided with air inlet holes—deprived this furnace of much of its excellence, for firemen discover that open, or part-open, doors admit air in lumps and destroy the benefit of finely-divided air streams such as filter through a heap of coal.

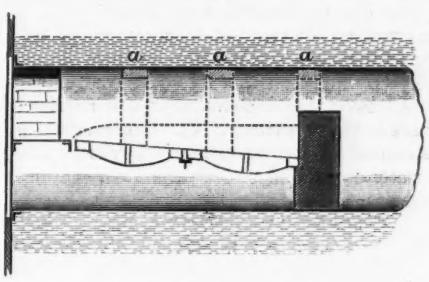


Fig. 2.

The development of the Cornish and Lancashire types of boiler made matters worse. In these boilers the furnaces were arranged as in fig. 2, and the long dead plate of fig. 1 was practically reduced, like the human hibernating sac, to a mere rudiment and, for many years, air openings in the doors were omitted or negligible in area, but where they existed the furnace had a correct form, but was deficient in facilities for coking, and there was the double disadvantage that not only was the crown of the furnace very near the fire, but the whole furnace periphery that was not grate surface consisted of cold plates, and the effect of this surrounding is such that it is only under most favourable conditions that smokeless combustion is secured, while the presence of cross-water tubes in the combustion space beyond the bridge is almost sure to cause smoke. These water-cooled furnaces are the fault of all the internally fired boilers, and the most obvious remedy would be several arches, *a a a*, of firebrick thrown over the fire to ward off the cooling effect of the plates and endeavour to conserve the temperature of the gases. There is no evidence to show that such arches would be very durable. Certainly, the most refractory clays would be necessary. The remedy is, however, worth trying, for the cost is low, and if the arches tumble down they merely require raking out.

The locomotive type of furnace, fig. 3, may now be considered. Surrounded on all sides and at the crown with cold plate and with ready and direct escape of the gases to the tubes, this furnace is bad in principle, for the gases rise directly from the fire and pass directly into small cold tubes, there is no admixture possible, even when extra air is admitted and smoke is inevitable. But as the locomotive had a powerfully forced draught a thick fire could be carried, and combustion was intense on the grate, and it was only its form and its surroundings that made the furnace bad.

Could the form be improved the effect of cold plate surroundings could be partly nullified by the high temperature. Some genius introduced the brick arch, as outlined in fig. 3. This altered the whole complexion of the furnace. It compelled all the gases that rose from the fire to travel round the projecting brick arch on their way to the tubes. This mixed

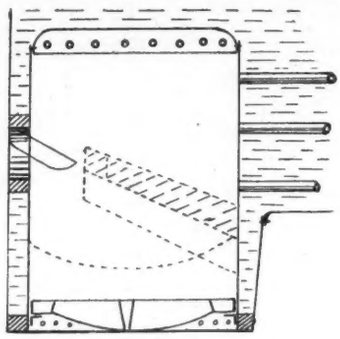


Fig. 3.

the gases from the whole of the furnace area with air admitted by a scoop at the door and the hot arch had a conserving effect on temperature. The space above the arch acted as a combustion chamber, and the gases only finally reached the tubes after a long journery. With a steam-induced powerful draught the locomotive is thus made fairly smokeless if its fireman cares to make it so. A study of a locomotive fire box with the brick arch will show that the conditions of fig. 1 have been fairly complied with.

A similar chain of reasoning led Broadbent to design his smokeless vertical boiler. No boiler is so bad as a smoke producer as the plain vertical, for the now obvious reason that the products of the furnace rose vertically upwards, and escaped directly to the chimney quite unmixed with air or amongst themselves (see fig. 4). To remedy this, Broadbent introduced a water table, as per the dotted lines, which, though water cooled and so far an undesirable element, did

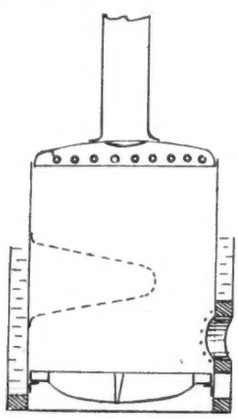


Fig. 4.

put the furnace into proper form, and compelled the gases to mix with air admitted at the door, and there was formed an ignition point, and a space for combination was left above the water bridge.

Vertical boilers have also been improved by hanging a tabular partial disc of fireclay a little over the level of the door, so as to give the effect of the Broadbent bridge in a better and refractory material.

With the foregoing standard examples before us the study of the water-tube boiler is simplified. As a general rule the one idea of water-tube men has been to crowd heat absorbing surface upon the fire irrespective of all conditions of combustion. This is all very well for a coke fire, because the combustion of coke is complete at the surface of the fire itself, or in a short flame, and if not so completed there is no colour to prove the contrary, as when bituminous fuel is used. The early water-tube boiler with which I was familiar at one time was the so-called Howard safety. This speedily showed up its qualities by a series of disastrous pipe rips, and it was abandoned, and water tubes fell into disrepute. They came back to us from America very crude affairs, largely of cast-iron, and apparently only suited to smokeless fuel of the well-known Pennsylvania anthracite class. The furnace of an ordinary form of water-tube boiler is as in fig. 5. The gases rise directly from the furnace and pass between the cold pipes.

This ends matters as regards the furnace, and we need not pursue the gases further. Recognising this fault and desiring to make their own boiler suitable for bituminous fuels, the Babcock & Wilcox Company brought out their

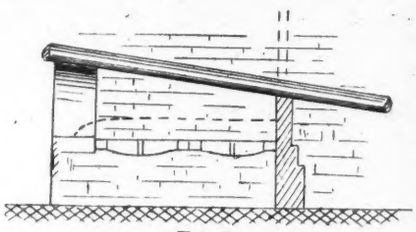


Fig. 5.

Scotch furnace. This furnace is as close an adaptation of the furnace of fig. 1 as the water-tube boiler of this type is capable of, indeed, it is in some respects superior, because, in the first place, the roof over the furnace is about half of firebrick, and the major portion of the four walls of the combustion chamber is of firebrick. The arrangement is roughly as in fig. 6. An additional layer of

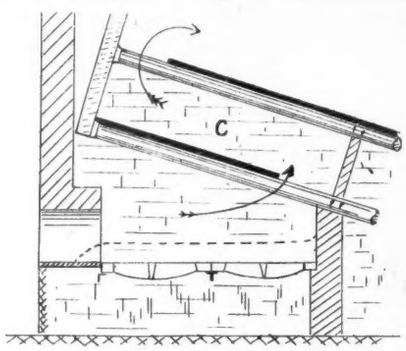


Fig. 6.

water-tubes is placed below the regular body of tubes, and forms with them a combustion chamber, C. On the new row of water-tubes is laid a cover of firebrick, and there is a similar layer on the row which forms the roof of the combustion chamber. There should be provision for the admission of fresh air in finely divided streams at the furnace door. This air and the gases off the fire all sweep along together over the length of the furnace and pass into the combustion chamber, having only been subjected to the cooling action of such part of the tubes as is exposed in the roof and at the uncovered part where entry to the combustion chamber is made. This combustion chamber is kept at a clear red heat, and a test of this device made with a very badly arranged air admission by a single opening 18 in. × 6 in. has shown me that the total smoke made during a day of ordinary working was negligible, that, in fact, the principle of refractory linings is correct not in theory alone, but in practice.

Where the arrangement of tubes permits of it, the best way of protecting them by firebrick linings is that shown in fig. 7, by means of two half-blocks put in place one

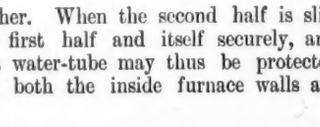


Fig. 7.

after the other. When the second half is slid into place it locks the first half and itself securely, and the whole surface of a water-tube may thus be protected. In the Weir boiler both the inside furnace walls and the outer

casing are all constructed in this manner, the form adopted in the Weir boiler being that of fig. 7A, but these

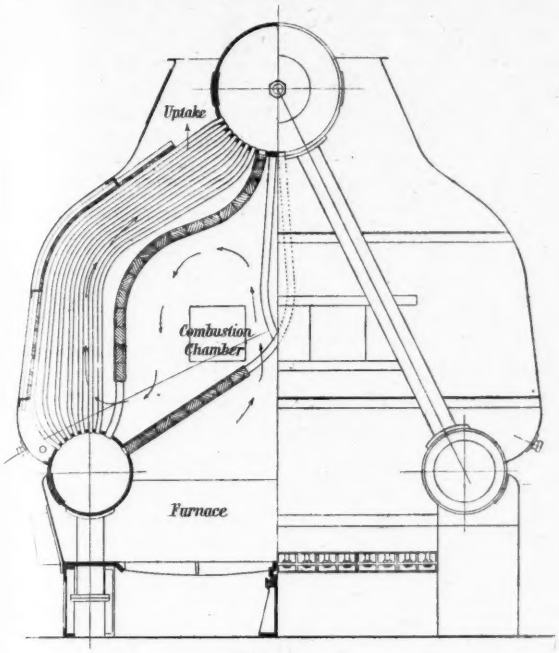


Fig. 7A.

formed fireblocks can be so formed, if necessary, as to cover a greater portion of the tube surface than that shown in fig. 7.

(To be continued.)

THE LOCAL GOVERNMENT BOARD AND LOANS FOR MUNICIPAL ELECTRIC UNDERTAKINGS.

The decision of the Local Government Board to authorise a loan for Tonbridge appears to establish the principle of ignoring the decision of the ratepayers, except as expressed by a majority of their representatives on the local Council. The evidence as to the opinion of the ratepayers which was submitted at the local inquiry was absolutely conclusive.

In the first place, an election for members of the Council, to supply the vacancies occasioned by the annual going out of office of one-third of their number, took place in March—when the election turned upon the question of the electric lighting scheme of the Urban District Council.

The addresses of the candidates were clear upon the subject. "I have come forward," said one of them, "to oppose the electric supply scheme, and to test the action of the present Council to plunge the town into so gigantic an undertaking without taking the opinion of the ratepayers on the matter."

Another said: "I am opposed to the present scheme . . . . I think the ratepayers should be first consulted in the matter."

A third candidate said: "The present contest is a most important one, as a majority of the existing Council wish to force on the town a scheme of electric lighting at a cost of £25,000 without asking your opinion, and that to supply but one-fifth of the inhabitants (if they all take it, which certainly is not probable or likely) . . . . therefore I oppose it."

All these candidates were elected; but still stronger evidence was presented at the inquiry of the feeling in the town, for a poll of all the ratepayers was taken, with the result that out of a total of 2,300 there were

For the scheme	187
Against	1,878
Neutral	244

In spite of this conclusive proof of the desire of the town to avoid the speculation, the Local Government Board have sanctioned the loan, the contracts for plant have been at once entered into, and the ratepayers involved in a municipal trading undertaking against their declared wish.

The action of the Local Government Board appears to be based upon the idea that once a provisional order is granted to a local authority, they are bound to sanction the provision of capital for carrying it out, provided the financial position of the town offers sufficient security for repayment of the loan, and the engineering scheme and evidence of probable demand satisfy them.

The Tonbridge case proves the necessity for an alteration in the conditions under which provisional orders for electricity supply are granted. At present the Board of Trade are empowered to grant an order on the application of a local authority, without any previous consent of the ratepayers, whereas in the case of the promotion of a Bill in Parliament, the standing orders require such consent to be obtained from a public meeting summoned in accordance with the Borough Funds Act, and a poll if demanded by a single ratepayer. Why should the procedure differ in the case of a provisional order, which has to be confirmed by Parliament and becomes an Act?

If the ratepayers had the opportunity of deciding *ab initio* whether municipal trading in electricity should be undertaken at their risk or not, there would at all events be a mandate to their representatives, who would be justified in their action; but being denied the opportunity of sanctioning the application, they have no control over the action of their representatives, if their opinion is to be set at nought by the Local Government Board when the crucial question is submitted to them of sanctioning the speculation.

If the Local Government Act provided for *all* the Councillors instead of only *one-third* being annually elected, the Tonbridge ratepayers would have settled the matter last March by returning members pledged against the trading scheme, but having given such an unmistakable proof of their hostility to the proposal, it is remarkable that the Local Government Board should have forced the undertaking upon them against their will.

A question might be raised as to whether a provisional order, necessarily becoming an Act of Parliament before it is operative, does not come within the provisions of the statutes requiring the previous consent of the ratepayers—before it is promoted—but in any case it behoves electors to be more alert in protecting themselves from the actions of those who so determinedly ignore their expressed wishes—and, when the day of election arrives, to see that only those are sent to represent them who respect their views on so important a question as trading in electricity supply.

The electric supply accounts of several local authorities have been issued during the last few weeks, and as object lessons, they will not be found pleasant studies for ratepayers who are being persuaded or forced into such speculations.

Take for example the town of Coventry, where the municipal trading commenced in November, 1895. The results for the fifth year's operations show an admitted deficit for the year of £2,250, the gross profit for the year not being sufficient to provide for the sinking fund—apart altogether from interest on loans, which amounts to £2,240—and antiquation or renewal of plant, for which another £3,000 should be set aside.

Another municipal trading account recently issued is that of the town of Bedford, where supply commenced in December, 1894, the accounts before us being for the sixth year of working. In this case the balance to the debit of net revenue account is £911 19s. 4d., but not a penny is provided for the depreciation and renewal of plant, which cost over £77,000, and at 4 per cent. would amount to upwards of £3,000. In the capital account £50 is placed to the credit for "sale of dynamo." It would be interesting to know the original cost, say six years ago, of this machine—as evidence of depreciation or antiquation. The public lighting is charged for at 3d. per unit, about one-third of the energy sold being used for this purpose, and another sixth to supply the sewage and water pumping at Newnham and the Embankment, private consumers paying 4½d. per unit.

There is a balance of £17,010 4s. 2d. due to the treasurer

—upon which interest should be charged to the electricity supply account.

Our space only admits of reference to one more account, viz., that of the Corporation of Dewsbury, where the supply also commenced in December, 1894. These accounts are for the sixth year of trading, and the deficiency admitted is £257 ; but if a reasonable amount were set aside to cover depreciation and renewal, the actual loss would exceed £1,800.

Local authorities have been warned by some candid consulting engineers that profits may not be expected for the first two or three years, although instances are quoted of favourable results, even for the first year ("Canterbury," forsooth, although, as a matter of fact, no profits have been realised as yet, if depreciation and renewal of plant be provided for), but the instances we have quoted are all for five or six years' trading, and they should serve as object lessons to those Councils which are still considering the question of who shall pioneer the undertaking.

THE INSTITUTION OF ELECTRICAL ENGINEERS IN GERMANY.

II.

After partaking of light refreshments provided by Messrs. Körting Bros., and toasting the firm with musical honours twice over, with Mr. Alexander Siemens's health sandwiched between, the party proceeded by electric tramcars to the municipal electricity works of the city of Hanover. The plant installed therein was supplied by Messrs. Schuckert, and was especially interesting on account of the construction of the dynamos, three of which were of the well-known, but now seldom seen, Schuckert flat-ring armature type. In addition to these there was a modern Schuckert dynamo of the multipolar drum armature pattern. Two of the machines were of 400 H.P. and two of 600 H.P. capacity, driven by Schichau vertical engines, and feeding a 110+110 volts three-wire network. The boilers were by Steinmuller, of the multitubular type. A large storage installation is in use, there being one battery of 1,320 ampere-hours' capacity, and four of 670 ampere-hours each. The regulating switches for these batteries are placed at a distance from the switchboard and operated by electro-motors.

In the evening the visitors were entertained in most hospitable fashion by the city of Hanover with a banquet at Kasten's Hotel; about 400 were present, and among the speakers were Herr Tramm, the Stadtholder, Herr Prücker, the city electrical engineer, Mr. A. Siemens, Mr. W. H. Massey, and Mr. R. Hammond.

Pretty little gilded porcelain insulators were distributed as souvenirs by Herr Prücker. The banquet terminated towards midnight in the hearty singing of "Auld Lang Syne," the British and Germans joining hands in the most jovial and friendly manner ; but it is said that many of the guests and hosts kept up the proceedings until the small hours.

Early on Monday morning (June 24th) the party left Hanover for Berlin, and after a brief interval of rest, proceeded to the Berlin electricity works of the Allgemeine Elektricitäts-Gesellschaft, in the Louisenstrasse. Here, in the Council Room, practical demonstrations with the Nernst lamp were given, accompanied by an excellent and lucid lecture in English. By means of a telephone receiver connected with an induction coil, the conversion of the Nernst filament from a non-conductor to a conductor at a certain temperature was aurally demonstrated, and the facility with which the lamps were "lighted" by means of a spirit torch, or blown out by a draught of air, was also shown. The necessity for the use of a resistance having a positive temperature coefficient was explained, on account of the high negative coefficient of the filament, and a curious curve illustrating the ratio between current and potential difference for the combination was shown. From this it appeared that it was possible to construct a lamp which should give constant candle-power over a wide range of voltage—the current remaining constant while the pressure varied 20 volts. It is interesting to recall that in the early days of carbon glow lamps, when constancy of pressure was as yet unknown, exactly the same problem arose, and was met in the same way by an invention of T. E. Gatehouse. Iron is the best material for the added resistance, owing to its high temperature coefficient and low cost, but it must be enclosed in an inert gas to prevent corrosion.

The beautiful effects of Nernst lighting were clearly shown, as well as the facility of manipulation. It was stated that platinum was used for the resistances in the smaller lamps, in order to save space. The efficiency was said to be 1·5 to 1·6 watts per candle, with a life of 200 to 300 hours. The suitability of the lamp for high-voltage circuits, and as a substitute for the arc lamp, was pointed out, and it was stated that the works of the A.E.G. for the manufacture of Nernst lamps would be quickly extended, and works started in England also.

The party then proceeded to inspect two of the electricity works of the A.E.G., which supply the City of Berlin.

LONDON UNDERGROUND RAILWAYS.

Report from the Joint Select Committee of the House of Lords and the House of Commons.

1. The Select Committee appointed to join with a Committee of the House of Lords to consider and report:—(1) Whether the lines of route for underground railways in and near London, proposed by Bills which have been or may be introduced during the present Session, are best calculated to afford facilities for present and probable future traffic; and, if not, what modifications of those lines of route are desirable; (2) what special provisions, if any, should be made for the protection of the owners, lessees, and occupiers of properties adjacent to underground railways from possible damage and annoyance; (3) what special terms and conditions, if any, as to construction and working should be imposed upon the promoters; (4) whether any, and which, of the schemes proposed by the said Bill should not be proceeded with during the present Session. Have agreed to the following report:—

2. Looking to the general terms of reference, it appeared to the Committee that these Bills were not to be considered and dealt with by them as by ordinary Private Bill Committees to whom they might have been referred; that the Committee had not, for example, to deal with the financial questions that ordinarily arise, nor with any special engineering details, and only partially and indirectly to consider questions of competition. They, therefore, called for no evidence upon these points.

3. For the purposes of this Report the Committee adopted the map handed in by Sir Alexander Binnie, on behalf of the London County Council, of the London Tube Railways, 1901, showing all lines open to traffic, in progress, authorised and proposed, from which it will be seen that the needs of considerable areas are unprovided for, specially north of the river in the neighbourhood of East and West Ham, and south of the river between Greenwich and Dulwich. This is possibly accounted for by the fact that the subsoil is of such a character as to make the construction of underground railways very costly.

4. The Committee have had before them 10 Bills proposing lines of routes for underground railways in and near London, or extensions of already authorised lines.

5. The difficulty in dealing with the question of the best routes is greatly increased by the fact that a considerable number of underground railways have already been authorised by Parliament; some of these have not been commenced, while others have been only partially constructed. It is obvious that any conclusions as to the best lines of route, or modification of the schemes now before Parliament, must be materially influenced by this fact.

6. The Committee think it may be useful to state, in the first instance, some general points which they suggest should be borne in mind when dealing with this question of routes.

(*a*) Underground railways or underground tramways in London and its immediate suburbs, which can be hereafter extended if required, above or below ground, into the country, but from the termini of which passengers could, for the present, proceed by electric surface tramways, omnibuses, and so forth, appear to be the best mode of dealing with the present traffic, and the probable requirements of an increasing population.

(*b*) These underground railways or tramways should run from well-recognised centres of traffic to other like centres of traffic, or from centres of traffic to districts whence large numbers of people have to be carried daily to and from their work in London or the suburbs.

(*c*) It is desirable that Parliament should carefully investigate the circumstances under which authorised lines apply for an extension of time. The result of many of the authorised railways having remained in abeyance for a considerable number of years has been in some cases to prevent other companies coming forward to make lines along the same route. The renewal, therefore, of lapsing powers should not be granted without the most careful consideration as to the probability of a company, which has already failed to carry

out its obligations to the public, being able by an extension of time to fulfil those obligations within a reasonable period.

(*d*) The Committee have been informed that the London County Council have had difficulty in getting a *locus standi* to oppose the renewal of powers before Parliament because they have not opposed the original scheme. The Committee are of opinion that the County Councils and the City Corporation should be granted a *locus standi* in all such cases where they are concerned.

(*e*) The underground lines may be worked at the termini on the shuttle system, or by means of terminal loops. Which system should be adopted in each case is a question for the Parliamentary Committee to which the Bill is referred. But while the advantages to the working of the line by loops are obvious, and in outside districts there can be no objection to them, the Committee think that very great caution should be exercised by a Committee in sanctioning them in the heart of the City on the ground of the large amount of space occupied to the possible exclusion of future railways. They have the less hesitation in making this recommendation as the multiple motor system, by which much time is saved in shunting at terminal stations, appears likely to be adopted in future.

(*f*) Confluent junctions inside tubes should be avoided, nor are they desirable in the open where the service of trains at the converging point is very frequent, since slight detentions on one line impair the service on both.

(*g*) We concur in the recommendations of the Joint Parliamentary Committee of 1892 as to the acquisition of wayleaves in the case of private property, and in the case of passing under the streets.

(*h*) One of the main objects of underground railways being to relieve traffic in congested places, it is desirable that stations should be so constructed as to avoid, as far as possible, the discharge of passengers into crowded streets. Interchange stations should, where practicable, be placed at all points where underground lines cross one another, and should be connected by subways, so as to facilitate the passing from one system to another underground.

7. Damage and annoyance to the owners, lessees, and occupiers of properties adjacent to underground railways may occur through one or other of the following causes:—

(1) Subsidence due to construction, especially to the construction of a station.

(2) Vibration due to the working of the railway.

1. The Committee did not think it desirable to receive evidence on the general question of underground railways causing subsidence; they considered that each case of probable or alleged subsidence must be judged by the circumstances of the particular case.

2. The Committee found that a Special Committee (known as Lord Rayleigh's Committee) was examining fully into the question of vibration, and it was decided, therefore, not to enter upon this part of the reference.

It was, however, thought desirable to have some short statement as to the proceedings of Lord Rayleigh's Committee, and at the second sitting a memorandum was handed in by the late Sir Courtenay Boyle. It concluded with the following statement:—

"The Committee may, in the meantime, say that from the information already obtained they believe that on new tubular railways, under proper conditions, no objectionable amount of vibration need be apprehended, but they abstain from a definite recommendation until the further experiments above alluded to are completed."

To wait for the final report of Lord Rayleigh's Committee would have necessitated considerable delay. As soon, therefore, as the evidence and arguments of counsel were concluded, the Committee decided to report upon the other parts of the reference, and to deal with the future report of Lord Rayleigh's Committee by the following general recommendation, namely:—

A clause should be inserted in every Bill binding the company to adopt and give effect to the recommendations, &c., which Lord Rayleigh's Committee may make.

As regards a line already authorised, such a clause can be properly imposed, if and when application is made to Parliament for an extension of time or of works.

8. The Committee find a want of uniformity in the clauses imposing upon companies an obligation to run trains in the early hours of the morning for the accommodation of workmen at specified fares; but every Act should impose clauses imposing these obligations, and the clauses in the Central London Railway Act, 1900, with some modifications suggested by the representatives of the Corporation of London and the London County Council, appear well adapted to secure the desired object.

9. The Committee have taken a considerable amount of evidence as to through fares for the various systems of railway proposed, and as to uniformity of fares. While there would be obvious advantages to the travelling public in both these proposals, and they would commend them to the consideration of the various companies, they cannot make any practical suggestion for their adoption so long as the interests involved are in various hands, but they recommend that the Board of Trade should make a report to Parliament every five or ten years on the working of these railways, of their relations to one another, and on the reasonableness of the fares charged thereon. They consider that such a report, while giving no absolute power regulating the conduct of the railways, would have a very strong moral effect in inducing the companies to take a reasonable view of their duties to the public.

10. The Committee proceed to report upon the several schemes for underground railways proposed by Bills introduced during the present session from the route point of view, leaving, as above stated, ordinary financial questions and other details to Parliamentary Committees.

The Bills that have been referred are as follows:—Central London; Charing Cross, Euston and Hampstead. No. 1 and No. 2; Islington and Euston; King's Road; West and South London Junction; City and North-East Suburban; North-East London; Brompton and Piccadilly Circus; Charing Cross, Hammersmith and District; Piccadilly and City.

11. The Central London Railway apply for power to make loops at each end of their line, so as to enable them to increase the number of trains and thus facilitate traffic. It appears to the Committee that there can be no objection to the proposed loop at the western end of the line. There is more difficulty with respect to the proposed loop at the east end of the line. This Bill may be referred to a Parliamentary Committee in the ordinary course, subject to the remarks contained in Paragraph 6, Sub-section (*e*).

12. Charing Cross, Euston, and Hampstead, No. 1 and No. 2.—These Bills may be referred to a Parliamentary Committee in the ordinary course. The Committee think that there should be no confluent junction on the authorised line. One of the branches should join end-on and the other should be connected by an interchange station. There should be no difficulty in securing this as works of the authorised line have not been commenced.

13. Islington and Euston.—This Bill may be referred to a Parliamentary Committee in the ordinary course.

14. King's Road.—This Bill may also be referred in the ordinary course if interchange stations are provided at Victoria. An extension to Putney Bridge would be desirable.

15. West and South London Junction.—This Bill may also be referred in the ordinary course.

The question has been raised whether there should not be an end-on junction with the North-West London, which might involve the abandonment of the line between the Marble Arch and Paddington Station. On the whole, the Committee think that the proposed scheme is the best, as securing the direct through route between Paddington and Victoria Stations.

16. It will be convenient to consider the City and North-East Suburban and the North-East London together.

(*a*) An extension further north of the North-East London would be very desirable, especially in view of the area of land taken by the County Council for building purposes. The Committee are of opinion that the Chingford branch is not wanted if the City and North-East Suburban is sanctioned.

(*b*) The Committee consider that that portion of the City and North-East Suburban route from the centre of the City along Bishopsgate and thence turning to the East to Victoria Park is not desirable, and they suggest that (unless engineering difficulties prevent it) a better route would be eastward from the centre of the City along Leadenhall Street or other streets in like direction, and thence in a north-easterly direction to Victoria Park. This would prevent the overcrowding of Bishopsgate with tubes, and would also bring communication to an overcrowded district of Whitechapel, which otherwise would remain without these facilities of rapid transit.

(*c*) Subject to the above remarks, it appears to the Committee that both these schemes may be referred in the ordinary course, as they both afford great facilities to crowded districts and to districts where building is increasing and likely to increase.

17. Brompton and Piccadilly Circus, Charing Cross, Hammersmith and District, and Piccadilly and City.

The Committee are of opinion that there ought to be one through line from Hammersmith along Piccadilly to Piccadilly Circus and the City. They consider it most desirable that there should be an end-on junction between the Hammersmith line and the City and Piccadilly at or near Piccadilly Circus. Failing that, the alternative junction at Charing Cross should be adopted so as to secure a through route.

18. The Committee, under the circumstances, do not approve the proposed extension of the Brompton and Piccadilly Circus line to Bloomsbury Square, but if the through line from Hammersmith to the City can be secured, an extension to the "Angel," Islington, from Piccadilly Circus, with an interchange station at the latter place, would be a useful route, and should receive favourable consideration.

19. In the course of their deliberations the Committee have had brought under their notice several matters which do not appear to lie distinctly within the terms of their reference. Of these the most important was the proposal that all these underground railways should be subject, within certain limits, to the control of a central authority. On this the Committee desire to make the following observations:—

The question of underground railways in London and the suburbs and of their working is so complicated, and of such importance, from a financial as well as traffic point of view, that the Committee are disposed to agree with the views of the Corporation of London and the London County Council, that in some way there should be a more direct control and supervision of all projects for such underground railways. Whether this should be effected by the supervision of some Public Department as the Board of Trade, or by some body like the Light Railways Commission, or by a Joint Committee of Members of both Houses of Parliament, appointed at the beginning of each Session, to consider all projects affecting the relief and distribution of traffic in or near London, is a question which appears to them to deserve serious consideration.

20. The railways should be constructed on sound economical principles and without undue inflation of capital. It is obvious that if dividends are to be paid on inflated capital, fares to produce such dividends must be on a scale higher than would be required to pay a fair remunerative interest on the money expended on the works. The Light Railways Act gives power to the local authority to construct, or to assist in the construction of light railways, and the Committee are of opinion that some such power given to the City Corporation and the county councils concerned in respect to London underground railways would be of the greatest advantage. They therefore recommend that the Board of Trade should insert in

each Bill a model clause based upon that in the Light Railways Act, with such modifications as may be necessary, giving powers to the City Corporation or the county councils in the counties in which the railways would be constructed, either to construct, or to aid in the construction of the lines.

21. Such powers would enable the Councils to encourage, by subsidy or otherwise, the prolongation of railways into districts thinly populated, and therefore suitable for the relief of congested districts, whereas, in many cases at any rate, a public company would not feel justified in extending their line till the population became greater.

22. It has indirectly been brought to the notice of the Committee that another system of underground locomotion, namely, that of subways or shallow tunnels immediately under the surface of the roadways, has been successfully developed, and is in process of further extension, both on the Continent and in America.

The Committee have heard no evidence with regard to this system; but in view of the large amount of capital involved in the schemes now before Parliament, and the importance of utilising it to the best public advantage, the Committee recommend that an early inquiry should be held by the Board of Trade upon this system.

LEGAL.

Bicknell *v.* the Kalgoorlie Electrical Power and Lighting Corporation.

The case of Bicknell *v.* the Kalgoorlie Electrical Power and Lighting Corporation, Limited, on 24th ult., came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Vaughan Williams and Stirling, on the application of the plaintiff for judgment or new trial on appeal from verdict and judgment dated June 13th, 1901, at trial before Mr. Justice Grantham and a special jury in the King's Bench Division.

This was an action brought by the plaintiff, Mr. A. C. Bicknell, in which he sued the defendant company for the rectification of its register of shareholders by the removal of his name as holder of 850 shares in the company, and for the return of moneys paid on application for shares in the company, on the ground that he had been induced to apply for shares in the company owing to the alleged misrepresentations in its prospectus. The defence was that there had been no misrepresentation, and the company counterclaimed for money alleged to be payable by the plaintiff in respect of calls. The appellant's case was that in September, 1889, a Mr. Wyman, who afterwards became a director of the defendant company, asked him to underwrite some shares in the company on the terms of its prospectus, promising him 250 deferred shares for doing so. The appellant went through the prospectus, and relying upon the statements contained in it he applied for shares, and was allotted 850. The capital of the company was £225,000, divided into 200,000 preferred shares of £1 each, and 25,000 deferred shares of the same value. The company was formed for the purpose of acquiring a site in the middle of the mining district of Kalgoorlie, in Western Australia, for the purpose of erecting a station for the supply of electric power to the towns in the immediate neighbourhood. To carry this out, the most important thing was to obtain a suitable site for the erection of buildings and machinery; but this was difficult, owing to the fact that the leases in the vicinity granted by the Government were mining leases, and it was difficult to obtain power to erect buildings on the land, owing to the fact that mining leases only allow the erection of such buildings as are absolutely necessary. The prospectus sent to the plaintiff contained a statement to the effect that a valuable lease had been obtained close to the Government railway, near Boulder City, and situated in the flat, from which large supplies of water were obtainable, and affording ample accommodation for the power house plant and administration buildings. It also stated that the mining rights over the land had been acquired, and that they might be of considerable value. The appellant's case was that these were mis-statements, and that there was no foundation for the statements that a valuable site had been obtained, or that large supplies of water were available. His case was, that at the time the prospectus was issued in 1889 no site of any description had been obtained, and all that was subsequently acquired was a mining lease, which was obtained in March, 1900, for 21 years. Among the other statements in the prospectus to which the appellant objected was one which said that no engineering difficulties were likely to be experienced in carrying out the scheme. He said that this statement was incorrect, since the water in the vicinity being salt, it was necessary to condense it before use, and the company had experienced great difficulty in dealing with the matter. The appellant having applied for shares on the faith of the prospectus, claimed to have his name removed from the list of shareholders. The defence relied upon was, that Mr. Bicknell had disentitled himself to ask for relief because of the time he had allowed to elapse before repudiating the shares. It was also submitted that, although *primâ facie* an allotment of shares was an allotment to the allottee on the terms of the contract contained in the prospectus, the action was not brought by a shareholder to whom the directors had issued a prospectus. The appellant's obligation arose owing to his having entered into an underwriting agreement, which did not primarily commit him to taking any shares at all. If the appellant was misled it was by the underwriters, and his real remedy was against them and not against the company. The defendants' case further was that the statements contained in the prospectus contained no misrepresentation. The jury at the trial found that the statements in the prospectus were true, and judgment was accordingly given for the defendants on the claim and counterclaim. Hence the present application of the plaintiff.

Mr. Rufus Isaacs, K.C., and Mr. Edward Clayton appeared for the appellant (plaintiff), and Mr. Lawson Walton, K.C., M.P., and Mr. J. W. McCarthy for the respondents (defendants).

The further hearing of the case was continued on 25th and 26th ult.

The Master of the Rolls, in giving judgment, after stating the facts and the cause of action, said that when the claim was launched the plaintiff claimed damages against the Corporation on the ground of fraud. It was clear that it was a claim for damages based on fraud, and the allegation was that he had been induced to enter into an underwriting agreement by misleading statements in the prospectus, and although the plaintiff alternatively asked to have his name removed from the register, when the action was brought his Lordship had not the slightest doubt in the world that it was an action of fraud brought against this company. The case had not proceeded far before the allegation of fraud all frittered away, and it had to be admitted by the learned counsel who appeared for the plaintiff that this gentleman had no case of fraud against the company whatever. It was clear from the shorthand notes that after the trial had proceeded a very short way the claim for fraud was entirely abandoned, and no charge of fraud was left to the jury. It was said, on behalf of the plaintiff, "Well, if I cannot prove fraud against the directors of this company, at any rate, in the prospectus there were allegations which were untrue." Although it was to be found, on looking at the shorthand notes, that many allegations in the prospectus were said to be untrue, the case of untruthfulness in the prospectus came down to this, viz., that the allegation that a "valuable site had been procured close to the Government Railway in Boulder City" was said to be untrue, and upon that ground it was said on behalf of the plaintiff that he was entitled to rescission of the contract and ought to have the Register of Shareholders rectified. It was important to look at the defence which the company had set up from the very first. The defences which the company set up were these:—The company, of course, denied and strenuously resisted that there was any fraud. That was one defence, and the company succeeded on that, and, indeed, the charge of fraud was dropped. Another defence they set up and insisted upon was that the plaintiff was not induced by anything which appeared in the prospectus to embark upon the underwriting letter and thus become a shareholder in the company. The company raised that defence, and insisted upon it to the last. The company had also another defence, and that was this:—Although they asserted that there was no untruth in the prospectus, they alleged that the plaintiff had been guilty of *laches*, and by his *laches* and conduct, even if there were an untruth in the prospectus, the plaintiff was not entitled to take advantage of it and get his name taken off the Register of Shareholders. All these defences were insisted upon throughout. His Lordship, having dealt with the evidence, said that it seemed to him upon the question of inducement that no reasonable jury would come to the conclusion that the plaintiff was induced to enter into the underwriting contract by any of the statements which were alleged to be untrue in the prospectus. When the summing up was read and the three questions which were left to the jury, it was easy to see what the verdict was that the jury found. His Lordship had no doubt whatever on the true construction of what took place that the jury found a formal verdict for the defendants, and so found that the plaintiff was not induced to become a shareholder by anything in the prospectus; secondly, that there had been *laches*; and, lastly, that there was no untruth in the prospectus. His Lordship did not see that the plaintiff, on any ground, was entitled to a new trial, and thought that the appeal should be dismissed with costs.

The Lords Justices concurred, and the appeal was accordingly dismissed with costs, as also the appeal of the plaintiff in the case of White *v.* the same defendants.

Geipel & Lange *v.* Day.

His Honor, Judge Lumley Smith, K.C., in the Westminster County Court, had before him on Tuesday an action by Messrs. Geipel and Lange, electrical engineers, of Westminster, to recover an account for electric cable supplied to the defendant, Frank L. Day, said to be trading as the Carlton Electrical Company, 10, London Street, Paddington.

Plaintiffs' case, as put by Mr. Duckworth, their counsel, was that these goods, to the amount of £12, were supplied upon verbal and written orders given in the name of the Carlton Company, and signed by Davis, Bagshawe & Clark.

Frank Louis Day said he had never traded as the Carlton Electrical Company. That firm had the lower part of the premises, and it was owned by a Mr. Davis. He was a cycle maker, and had the first floor of the building only. Witness said he left the building before these goods were supplied. In cross-examination, he said he did not reply to the letter before action, because he thought plaintiffs would be sure to find out their mistake.

His Honor said this could not be carried further, and gave judgment for the defendant with costs.

C. Bright & Co., Limited, *v.* The River Plate Construction Company, Limited.

In the Court of Appeal last week, before Lords Justices Rigby, Collins and Romer, the case of C. Bright & Co., Limited, *v.* The River Plate Construction Company was heard on two appeals by the plaintiffs

from an order of Mr. Justice Farwell dismissing the actions as frivolous and vexatious and as disclosing no reasonable cause of action. Mr. Bramwell Davis, K.C., who, with Mr. Stewart Smith, appeared in support of the appeals, said that in the second action the learned judge had dismissed a motion by the plaintiffs for a receiver and for an injunction to restrain dealing with bearer shares in a Monte Video tramway company.

Mr. Upjohn, K.C., who appeared with Mr. Hume Williams, K.C., and Mr. McSwinney for the respondents, raised the preliminary point that there was an interlocutory appeal with which leave to appeal was required, and in this case leave had not been asked for and had not been given.

Mr. Bramwell Davis submitted that the case came within the exception of the Acts.

Their Lordships were of opinion that leave was required, but decided to hear the facts of the case in order to decide whether leave should be given.

After hearing Mr. Bramwell Davis at some length, without calling upon the other side, Lord Justice Rigby said he did not think the plaintiffs had made out any case, and they would decline to give leave to appeal. The application in both appeals was accordingly dismissed with costs.

An application by Mr. C. Bright for leave to appeal from an order of Mr. Justice Farwell in an action he had brought against the London and Brazilian Bank and others was also refused, with costs.

Howell's Simplex Anti-Inductive Telephone Syndicate, Limited.

The matter of Howell's Simplex Anti-Inductive Telephone Syndicate, Limited, was again before Mr. Justice Wright in the Chancery Division on Wednesday last week, on a summons by the liquidator dealing with the claim of Mr. T. J. Howell, an electrical engineer, who alleges that his patents were sold or transferred to the syndicate, and that he had had no adequate consideration for them. He sought to recover in the liquidation, and the liquidator asked for instructions as to dealing with his claim.

Mr. Black, who appeared for Mr. Howell, said the latter was an electrical engineer, and although totally blind he had invented some valuable improvements in telephones. He had no capital with which to exploit them himself, but he was introduced to a Mr. James Gordon McIntosh, and he agreed to receive £600 in cash, and one-third of the shares in a syndicate which Mr. McIntosh was about to form. McIntosh then entered into a fresh agreement with the syndicate to sell to it the patents he had obtained from Mr. Howell for £2,500 in cash, and 5,450 ordinary shares. The syndicate got Mr. Howell's patent rights for Great Britain and abroad, and its capital was £12,000. The syndicate was now being voluntarily wound up, and Mr. Howell having failed to get the price agreed upon from McIntosh now sought to prove in the liquidation. His Lordship, said counsel, on the last occasion on which the matter was before him, said that Mr. Howell had been badly treated, and that there might possibly be grounds for formulating charges of fraud and conspiracy against McIntosh and the syndicate. Since that time evidence had been obtained which, to his mind, greatly strengthened Mr. Howell's claim, and he put in affidavits which he said made the matter clearer, and an agreement which established the connection between Mr. Howell and the syndicate, and the assignment to the syndicate of his patents.

Mr. Cassells said that on the last hearing the liquidator of the syndicate agreed to let Mr. Howell have his patents back for £270, the price which they had paid for them, but the liquidator had since found that Mr. Howell had attempted to sell the articles and patents which were still in the hands of the company.

Mr. Black denied that that was the case.

His Lordship said he could not go into that. There was no new material before him to enable him to come to a different conclusion. The assignment was by McIntosh to the syndicate, and there had been no consideration as between Howell and the syndicate. He thought that Mr. Howell had been a great sufferer by somebody's dishonesty, but his application had not been strengthened, and therefore he must decide against him. The claim would be dismissed with costs.

Mr. Cassells remarked that misfeasance proceedings had been commenced by the liquidator against some of the directors of the syndicate.

J. Ambler & Sons, Limited, *v.* The Mayor, &c., of Bradford.

This case which has been before Mr. Justice Joyce in London for several days, was taken by the plaintiffs, the owners of mills at Bradford, who sought an injunction to restrain the defendants from interfering with the natural flow of a beck, or small stream, and thereby causing damage to the plaintiffs' works. It appeared that in 1864 the plaintiffs purchased a large plot of land for the purpose of building their mills, and in subsequent years bought other property to extend their premises, the lands being situated on both sides of a stream. Some time ago the Bradford Corporation erected electrical plant in the neighbourhood, and with the object of accumulating the water, they put up two sluice gates a little distance below the plaintiffs' mills. The result was that when the heavy rains came in July last year the water could not get away quickly enough, and flooded the plaintiffs' premises, doing a great amount of damage, amounting to, it was said, several thousand pounds. The defence substantially was that the damage was done by an extraordinary storm which it was impossible to foretell or take precautions to prevent, and that consequently the defendants were not liable. A great number of witnesses were called on both sides. Judgment was reserved.

Peter Pilkington *v.* Yeakley Vacuum Hammer Company.

Before Mr. Justice Kekewich in the Chancery Division last week, plaintiff, of Accrington, claimed an injunction from the defendants to restrain them from infringing his patent right in atmospheric power hammers, plaintiff having acquired his patent by assignment from Mr. Thomas Jameson, the patentee. Defendants admitted the infringement, but denied that plaintiff had any right to the patent, as they alleged a prior publication by them of the principle for which the patent was granted. At the same time the defendants admitted having themselves taken out a patent for the same invention at a later period than the patent obtained by Mr. Jameson.

Mr. Justice Kekewich held, without calling witnesses for the plaintiff, that the defendants had entirely failed to make out their case, and gave a verdict on all points for the plaintiff. He also granted a certificate of the validity of plaintiff's patent. The verdict carried costs.

PARLIAMENTARY COMMITTEES.

Manchester and Liverpool Electric Express Railway.

On Monday last week the Committee resumed, and Mr. R. C. Cooper, the joint engineer with Mr. Behr for the promoters, was recalled, and was questioned by the Chairman regarding the dangers of the mono-rail system. Witness submitted that even where the centrifugal and the wind forces were both acting on one side of the car there would be no overturning pressure bearing on the car, but only a sliding pressure. He disagreed with the proposition that there could be any possibility of derailment through the guide wheels being provided with springs. The effect of the centrifugal force would be eliminated to a very considerable extent wherever there were curves on the line by the fact that the sleepers would be tilted to facilitate the car's passage round the curve. He had made allowances for such contingencies as the rails expanding or contracting.

Further witnesses were called on behalf of the Cheshire Lines Committee in opposition to the scheme, especially with regard to the difficulty of working on the railway to keep the line in order while trains were running.

At the sitting of the Committee on 24th ult. Prof. Short, an American electrical engineer, stated that in his opinion the scheme was visionary and unpractical. He considered that on neither of the cars proposed could a sufficient motor be fitted. He believed that the weight of the car in motion would cause a depression in the rail. It was true that he was interested in the sale of electrical plant, but his opposition to the scheme was not based in any way on the fear that it would interfere with the sale of his plant.

Mr. S. Sellon stated that he had been actua' y engaged in electrical traction for years, and was consulting engineer to several Corporations. He was chief engineer to the British Electric Traction Company, which had 3½ millions of money invested in it. Having carefully considered the scheme he believed it crude and unpractical, and that the importance of having a speed of 110 miles an hour had been very much exaggerated. He believed that frequent service was more important than speed. He considered that with regard to the suggested scheme the capital expenditure was excessive, and it would not be a commercial success. He could work a railway on the two-rail system between Liverpool and Manchester with a capital expenditure approximately of £200,000, to give a service of cars every 10 minutes travelling at between 50 and 60 miles an hour. The great success of electrical traction had been that a frequent service of cars was given with stoppings for the convenience of passengers.

Evidence was then called as to the punctuality of the train service of the Cheshire Lines.

At the resumed sitting of the Committee of this Bill on 25th ult. further evidence was given in opposition to the scheme.

Mr. Shaw, who addressed the Committee on behalf of the Lancashire and Yorkshire Railway Company, first expressed deep regret at the death of Mr. Pope, who had represented the company in both Houses. He went on to say that large sums of money had been spent by his company in developing and working the traffic between Manchester and Liverpool, not only in passenger, but goods traffic. He was strongly of opinion that it would be a great hardship to them, unless an eminent public want was proved for the new line, that they should be deprived of the advantages of the traffic.

Mr. Littler, K.C., for the London and North-Western Railway Company and the Cheshire Lines Committee, contended that the proposed line was of a very complicated character, and pointed to the failure of the Ballybunion Railway in Ireland. He maintained that the scheme, as contemplated by the promoters, was a wild one, except so far as the Brussels trial was concerned. At the present moment there was an adequate service of trains between Manchester and Liverpool, and therefore he thought the proposed new system was entirely unnecessary, and would, if constructed, prove a financial failure.

Mr. Balfour Browne, replying for the promoters, said it was unnecessary for the Committee to consider very closely the details of the proposals, for the Board of Trade would not sanction the running of the line until it had been proved to be perfectly safe. High speed could not be maintained on ordinary railways going round curves, but the highest speed would be maintained on this line without any danger. The invention was a very simple one, for

it merely resolved itself into the fact that the centre of gravity was below the top rail. The greatest inventions were simplicity itself, and he contended that that invention being so simple was a great scheme, and would revolutionise railway travelling.

The Committee adjourned.

The Committee sat on 26th ult. and the Chairman at once proceeded to announce their decision. He said the Committee regarded the proposal contained in the Bill as being rather in the nature of an experiment on a practical scale of a novel system of locomotion and traction than as an ordinary railway Bill. Therefore, as the questions before them were conditioned by new factors and new considerations, they were necessarily constrained to modify the application of some of those principles which ordinarily governed the decision of railway Bills. For instance, the competition question practically disappeared. Indeed, and very properly, it had hardly been pressed. There was no competition. If the mono-rail was started and succeeded up to or nearly up to the point claimed for it by the promoters, it would, of course, annex a good deal of the express passenger traffic of the existing lines in the neighbourhood, just as the railway absorbed the express coach traffic, and if it succeeded it deserved to do that and would be benefiting the public in doing so. If it did not succeed it would not annex the traffic, and it would not injure the Cheshire lines. Similarly, in the case of an important experiment which might result in great advantage to the public, the Committee was disposed to some extent to relax the severity with which it would ordinarily examine the financial prospects of a railway scheme. The money for making that experiment appeared to be forthcoming, but having regard to the sums that would inevitably be invested in similar works, should that one prove a success, the amount did not seem disproportionately large, and the Committee were not inclined to accept the responsibility involved in stifling a promising new departure merely on the ground of possibly poor returns to the future shareholders. In the present galloping evolution of locomotion, new developments of which present themselves every month, that would be a reactionary policy. Much money would inevitably be expended on experiments before the ultimate solutions were arrived at. Having said so much in those directions, there were on the other side very grave considerations which arose from the novel and experimental character of the proposal. In the ordinary railway Bill, a Parliamentary Committee had to trouble itself but little with such questions. On the other hand, the practice of those rooms extending over some 70 years had built up a corpus of provisions, meeting one such set of provisions; and on the other hand, the department concerned had gradually evolved a code of rules, restrictions and limitations, enforced by a most competent system of inspection, which amply provided for the safety of the public in relation to railway traffic. But for the purpose of that Bill, the existing Board of Trade railway practice would be of little or no service. The Board of Trade had no established doctrine in relation to such a method of construction as that on the table before them. No preconceived ideas, much less rules, contemplated any one of a dozen novel features inherent to that scheme, and what was perhaps even more important, on an ordinary railway the Board of Trade inspector intervened only after construction. Clearly in the case of an entirely new system devoid perhaps of some familiar dangers, but beyond question, fraught with large potentialities of new and perhaps very serious dangers, the ordinary powers and the department were inadequate. Although that system might get rid of some well-known sources of accident, it had been obvious all along, even to the modest intelligence of the Committee, that in a scheme of the novel and unusual character of that proposal, there must almost inevitably be novel and intrinsic dangers and difficulties. When that view was tentatively suggested to the eminent experts for the promoters, they with one accord repudiated and scouted the suggestion; they knew of no such potential dangers, they had not in fact come before them for the purpose of giving evidence of that sort. On the other hand, the advisers of the petitioners suddenly woke up to possibilities of resistance which had escaped them in another place, and with a fertility of resource most commendable, and an ingenuity wholly admirable, they had succeeded in producing, during the last few days, a positive inferno of dangers, scientific and blood curdling, which had greatly comforted the Committee. The Committee listened to much suggestive and much ingenious evidence as to those possible dangers. They had taken a very wide range in their several degrees of gravity. Some of them were fairly obvious, others seemed real and serious enough in all conscience, while others had been clearly prepared for the Committee's consumption. But taken altogether, the Committee were satisfied that there was a case in the interest of the public safety demanding special care and special treatment, and the Committee were of opinion that an experiment of that sort, if made at all, should be hedged by every reasonable precaution and safeguard available, and in certain respects ought to be subjected to conditions analogous to light railways. The point he put to Mr. Balfour Browne was, in the event of the Committee showing a disposition to pass the preamble of the Bill, were the promoters prepared to accept, to a certain extent, conditions which seemed suitable to the promoters of a novel scheme like that, viz, the position of light railway and tramway projects? Were they prepared to insert clauses binding them before construction to submit for approval to the Board of Trade plans and other details of construction and material in respect of permanent way, rolling stock, mode of working, electric installation, system of signalling, system of braking, and also satisfy the Board of Trade as to their scheme for the effectual maintenance of the permanent way and the exclusion of the public from trespass on the permanent way? Furthermore, were they prepared, at the company's expense, to conduct, under such conditions as the Board might prescribe, experiments which the Board might desire them to make with a view of determining whether such approval might properly be given in any of those cases? Lastly, they thought that Clause 59 should be so extended in relation to the question of electric power to such regulations as the Board might prescribe to ensure the safety of the public and the company's servants in relation to electricity.

Mr. Balfour Browne said that with regard to those statements he could, without consulting his clients, at once give a categorical answer. They would submit to those conditions without hesitation.

The Chairman: Then by a majority we declare the preamble proved.

Mr. Balfour Browne said they had practically arranged clauses with those persons interested—the railway companies and the Cheshire Lines Committee especially—and a short adjournment would allow them to bring up the clauses in their agreed form.

The Committee then adjourned.

On Tuesday the Select Committee sat to dispose of the clauses in the Bill, when it was agreed to insert the following clauses to carry out the decision of the Committee so that a reasonable protection should be secured to the public and to the servants of the company against danger arising from the use of the railway:—(1) Three months before commencing the construction of the railway the company shall submit for the approval of the Board of Trade plans, sections, and other details of their proposals with respect to (*a*) the construction and materials of the permanent way and proposed mode of maintenance thereof; (*b*) rolling stock; (*c*) mode of working, including system of signalling; (*d*) electric installation; (*e*) system of braking; and (*f*) mode of fencing and prevention of trespass.

(2) The Board of Trade may require the company at any time during the construction of the railway to conduct at their own expense such experiments as that Board may desire to have made with a view to determining whether the arrangements of the company in respect of matters referred to in this section are satisfactory, and the company shall comply with any such requirements before opening the railway for the public conveyance of passengers

(3) The Board of Trade may make regulations for giving effect to all or any of the foregoing provisions of this section, and to passengers, and to the servants of the company, all reasonable protection against danger arising from the use under this Act of electrical power on the railway, and for regulating the use of electrical power.

(4) The company, or any other company or person using any electrical power on the railway contrary to the provisions of this Act, or to any regulations made by the Board of Trade under this section shall, for every such offence, be liable to a penalty not exceeding £10, and also, in the case of a continuing offence, to a further penalty not exceeding £5 for every day during which such offence is continued after conviction thereof.

(5) The provisions of this section shall be in addition to and not in substitution for any provisions for the protection of the public and of passengers and of the servants of the company contained in any general Act relating to railways which were applicable to the railway and the company.

Some discussion took place as to the omission of any definition in the Bill as to what was meant by "the use of the railway." Counsel pointed out that if the clause was carried as it stood, the promoters would be at liberty to construct the railway if the Board of Trade did not intervene within three months after the date of submission of plans.

The Committee agreed that the words "three months" should be omitted, and that with reference to the definition of the use of the railway no alteration should be made.

Some further small alterations were made in the clauses, and the Bill was ordered to be reported to the House for third reading.

Hendon Tramways.

A Select Committee of the House of Commons presided over by Mr. Jeffreys, on Monday, commenced the consideration of the Hendon Tramways Bill.

Mr. Freeman, K.C., who with Mr. Littler, K.C., and Mr. Clode, appeared for the promoters, opened the case. He said that the Bill was one to authorise the construction of certain tramways beginning at Golder's Green, Hampstead, going in one direction to Hendon and in another to Mutton Brook, on the border line of Finchley. At first they intended to continue the line into Finchley, but as the local authority would not give their consent, they had been forced to drop that part of the Bill. He reminded the Committee that the Charing Cross and Hampstead Underground Railways had already received powers to construct their line as far as Hampstead, and they had promoted the extension to Golder's Green, and if that was done, there would then be direct communication between Golders Green, Charing Cross and throughout London generally.

Replying to the Chairman, Mr. Earle, who with Lord Robert Cecil, K.C., appeared for the Middlesex County Council, said that that body opposed the making of the tramway because they said it would spoil their larger system which they had in view. They did not dispute that there ought to be a means of traction along the road.

Evidence was then called in support of the Bill, Mr. Page, the Chairman of the Works Committee of the Hendon Urban District Council, giving it as his opinion that the majority of the residents in the neighbourhood would like to see the tramway made.

By Mr. Earle: He could not agree that the Middlesex County Council had shown themselves anxious to promote a comprehensive scheme of light railways in the district. On the contrary, the

were not liable. A great number of witnesses were called on both sides. Judgment was reserved.

round curves, but the highest speed would be maintained on this line without any danger. The invention was a very simple one, for

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Council had opposed several tramway schemes, but when asked for a proposal of their own, were obliged to confess that they had not got one.

Mr. Yerkes gave evidence as to the financial character of the promoters, and said there was no doubt that there was ample capital to carry the undertaking through to a successful issue. He was interested in the Charing Cross and Hampstead tube line, which had applied to Parliament for powers to continue the line through Hampstead to Golder's Green, where it was their intention to join it on to the line of tramways from Hendon and Finchley.

Mr. Davidson, C.E., the engineer to the tramway company, said that the tramways would be 3 miles 2 chains in length and wholly in the district of Hendon. The district now was a purely rural one, and he agreed that the fact of tramways going there would be to transform it into a suburban district, and eventually it would become part of London. It was proposed to run a service of trains every five minutes, and they reckoned that the journey, which now took an hour, would be accomplished within half an hour by means of the new railway and their tramways. Personally, he thought that the scheme would enhance the value of the land and not depreciate it.

The Committee adjourned.

After hearing evidence in opposition to the scheme, the Committee announced that they had unanimously come to the decision that the preamble of the Bill was not proved.

Electric Light Provisional Orders.

On Friday electric light provisional orders Nos. 7, 8, 9, 11 and 12 came before the House of Commons Committee on Unopposed Bills, and were ordered to be reported for third reading. Full particulars of the area covered and the undertakers have been given from time to time in the Electrical Review as the Bills have come before the examiner of standing orders. The orders confirmed are in respect of the following districts:—Barry, Ampton, Foots Cray, Friern Barnet, Isle of Thanet (rural), Newbury, Pudsey, Ross, Roundhay, Royton, Alnwick, Annfield Plain, Benfieldside, Consett, Handsworth, Norton, Pickering, St. Austell, Sheldon, Whitley and Monkseaton, Bromsgrove, Goole, Ilkley, Lyndhurst, area of Midland Electric Corporation for power distribution, Northwood and Ruislip, Rickmansworth, Riston, Great Harwood and Clayton-le-Moors, Warwick, Lewisham and Penge, Clydebank, Crieff, Dalkeith, Dollar, Falkirk, Galashiels, Gourock, Jedburgh, Melrose and Oban.

Tramway Provisional Orders.

On Friday Tramway Provisional Orders Confirmation Bill (No. 2), which has already passed through the House of Lords, was before the House of Commons Committee on Unopposed Bills, and was ordered to be reported for third reading. The Bill confirms Board of Trade Tramway Orders to the Urban District Councils of Birkdale, Crompton, Royton and Wrexham, the Corporation of Swindon, and in respect of the Borough of Leamington.

CORRESPONDENCE.

The Shoreditch Dust Destructor.

Replying to your query by "Voltmeter," I should be perfectly willing to express my views on refuse destructors and electric generators, upon one condition, viz., that your anonymous correspondent (good, bad, or indifferent voltmeter as he may be) mentions his real name, so that one may know who they are discussing with; for at present I find my time is very fully occupied in the making of renewable lamps (which, by the bye, we do not advertise in the editorial column, every time we receive an order for a few hundred) to trouble about answering anonymous correspondence.

H. E. Kershaw, *Mayor.*

Town Hall, Shoreditch, E.C.
July 29th, 1901.

[We cannot break through our rule of treating writers' names in confidence if they prefer anonymity. Would the Mayor of Shoreditch vary his statements regarding the Shoreditch plant according to the person who asked questions concerning it? We have long been aware that the Mayor of Shoreditch was energetically pushing the sale of renewable lamps, which he "advertises in our editorial column" (his letter being also written on Shoreditch municipal paper), but we call to mind that when he ran the dust destructor, even that enterprise permitted him to reply to anonymous correspondence. We have no doubt that a dozen electrical men would be prepared to subscribe their names if thereby they could learn from the pen of the managing director of the Renewable Lamp Company his very interesting story of the Shoreditch refuse destructor and its performances, and his latest views regarding the undertaking.—Eds. Elec. Rev.]

Forced Draught v. Steam Jet.

We have read with some interest a letter on p. 54 of your issue of July 12th on "Forced Draught *v.* Steam Jet," in which the writer suggested that Mr. Highfield or Mr. Wordingham should give further information respecting the use of steam in refuse destructors.

We think the following extract from a report on our destructors, made by Lord Kelvin and Prof. Barr, answers the questions satisfactorily.

Trusting this may be of interest to your readers.

The Horsfall Destructor Company, Limited,
G. Watson, *Managing Director.*

Leeds, *July 29th*, 1901.

"A second important feature in this connection is the use of steam jets to produce the forced draught. The steam so used is condensed by contact with the cold air which it injects, and the water thus produced is re-evaporated in contact with the furnace bars, keeping down their temperature. In this way the life of the furnace bars is greatly increased. A more important function is, however, fulfilled by the steam. In coming into contact with the incandescent fuel it is decomposed, the hydrogen being freed while the oxygen combines with the carbon in the fuel to form carbon monoxide. This decomposition of the water is effected by heat abstracted from the lower part of the fire, where it can be of comparatively small value for the cremation of the distillate. The "water gas" (hydrogen and carbon monoxide) passes upwards to be burned by the excess air which it meets with over the fire, thus serving to increase the temperature which would otherwise exist at the meeting of the products of combustion with the gases distilled from the raw material.

The gases next pass through flues, the walls of which are constantly maintained at a glowing temperature. The effect of the hot brickwork was well illustrated by observations which we made on the Bradford plant. In watching, through the open clinkering door of a cell, the operation of raking forward a charge on to the grate bars, dense smoke, as might be expected, was observed; but on looking through a sight hole at the end of the main flue no trace of such smoke could be seen issuing from the discharge end of the cell flue, and only the faintest trace of discharge (probably consisting largely, if not entirely, of steam) was observable at the chimney top. The absence of any hydrocarbons from the products of combustion, as shown by the analyses given below of flue gases collected at Oldham, may be taken as a further indication of the completeness of the destruction of all organic matter in the plant tested."

Station Lighting.

My attention has been drawn to an article under the above heading in your issue of June 21st, and although the conclusions arrived at by its author are in the main in accordance with the latest experience, there is one point to which exception must be taken, viz., the denunciation of enclosed lamps. He has referred to American practice in the matter of series lighting, but has omitted to state that at the present time in the States more enclosed lamps than open ones are being installed, the *majority* being for alternating current, and immense numbers of second-hand open lamps are being offered for sale. The writer may, perhaps, be pardoned drawing attention to an article in *Electrical World*, December 5th, in which the relative advantages and cost of the two types are discussed at some length, and would add that several years' experience of some hundreds of enclosed alternating lamps, both series and parallel, has convinced him of the soundness of American practice in this matter.

With the lamps referred to no choking coils or transformers are necessary, the lamp being fed direct from the 200-volt low pressure mains.

T. H. Minshall.

Croydon Electricity Works.
July 30th, 1901.

Central Station Man's Grievance.

I should like to be allowed, through the medium of your valuable columns, to call attention to a matter which is of the utmost importance to the younger members of the electrical profession. It is becoming quite a common practice among municipal authorities and others who own or command electric lighting and power stations to import into

braking, and also satisfy the Board of Trade as to their scheme for the effectual maintenance of the permanent way and the exclusion of the public from trespass on the permanent way? Furthermore, were they prepared, at the company's expense, to conduct, under such

in the neighbourhood would like to see the tramway made.

By Mr. EARLE: He could not agree that the Middlesex County Council had shown themselves anxious to promote a comprehensive scheme of light railways in the district. On the contrary, the

their works as charge engineers, a type of man totally unfitted to occupy such a position.

I do not intend to waste your valuable space by speaking in vague terms on generalities, but will confine my attention to cases which have come within the reach of my own observation.

In a lighting station in the North of England, owned by a very wealthy corporation, six shift engineers are employed, and of this six, no less than four belong to the class of marine fitters, to which I have already made reference; one of them told me that before he obtained his present position (which was that of charge engineer in the above station at 35s. per week), he was at sea, in the position of engineer, at £15 per month and all found.

Now, sir, my object in writing this epistle is to call the general attention of the electrical profession—and more especially that of its younger members—to the fact that this usurpation is largely on the increase, and that if steps are not immediately taken to stop it, students will soon find themselves in such a position as will make them regret the day they decided to enter the profession of electrical engineering.

I enclose my card, but beg to subscribe myself—

An Enlightened Student.

THE B.T.H. NEW WORKS AT RUGBY.

THE electrical works of the British Thomson-Houston Company, Limited, at Rugby, of which bare mention has been made in our columns from time to time, are now so far advanced as to merit a more extended review than has been heretofore possible, and we are in a position to give our readers a brief outline of what, when completed, will of course be an up-to-date works.

Much care and thought has been spent on laying out the works, and the best experience of the Continent and America has been drawn upon in planning them. On account of the inability of the contractors to secure building material as promptly as anticipated, the works are not in the forward state of completion that it was expected they would be by this time. It is now, however, anticipated that, if no unforeseen difficulties arise, work will be begun on patterns in about two months' time, and in the machine shop by the end of November; the entire works to be in operation in six months.

The works are well situated, on land which was formerly the glebe farm, lying north of the L. and N.W. Railway station, and west of the Brownsover Hill Road, running north to the historic Avon, from which a plentiful supply of water will always be available for steam generating purposes.

The site comprises 24½ acres, of which 8 acres will be covered by roads and buildings, the latter having a total floor-space of 200,000 sq. ft., most of which is under cover. As extensions of the works are required from time to time, the buildings are so planned that they can be made without in any way interfering with production, so that both extensions and production can be carried on simultaneously. The B.T.H. Co. have made a private road from the Brownsover Road leading into the works. By the side of this road a viaduct is built and fenced off, which connects with a siding of the London and North-Western Railway. Both the L. & N.W. and the Midland Railways are to be connected with the works by spur tracks, so that the facilities for handling material will be ample, the canal on the N.E. furnishing more facilities if it is found desirable to ship by water.

The buildings at present completed, but not fully equipped with machinery, are the power house, steel stores and smithy, punch and annealing shop, office building, gate house, pattern shop, and pattern stores. Those partly completed, and more or less roofed in, are the brass foundry, iron foundry, machine shop, the stores, and warehouse.

The construction of these buildings is of steel and brick throughout, and they are practically fireproof. On all buildings requiring the maximum of overhead light, glass roofs have been erected, while large windows in the sides of the buildings give ample side light. The artificial light will, of course, be by means of electric arc and incandescent lighting. All of the buildings will be heated in winter by means of hot air, propelled by powerful blowers, which will also, at the same time, provide the necessary ventilation. The lavatory accommodations for the operatives are designed on a scale to compare most favourably with the best works on the Continent or America, there being in all of the shops hot and cold water for washing, in addition to which each operative will have a locker allotted for keeping clothes, &c., in, experience having demonstrated that operatives that are most cleanly in their habits are more skilful and careful in their work.

All the machine tools, which are of the most modern and up-to-date English, American, and Continental makes, are to be electrically-driven, the large tools by direct connection to individual motors, and the smaller tools, conveniently grouped, by short lines of shafting. The large 84-in. planers are to be operated by the B.T.H. magnetic clutch drive, which permits the motors to continuously rotate in one direction, the reversing of the machine being accomplished by the magnetic clutch.

The buildings have been so situated as to have the work pass in at one end, and continue through the various operations progressively, until it reaches the testing department as the finished article, with the minimum of handling in its progression through the works. In the buildings, where heavy pieces of machinery are to be handled, overhead electric travelling cranes, of which there are 11, are to be installed, with capacities of from 2 to 40 tons. These are distributed as follows:—Iron foundry, one 30-ton and two 2-ton cranes; machine shop, one 40-ton and three 5-ton cranes; stores and warehouse, each one 5-ton crane; steel stores, one 2-ton and one 3-ton crane. In the annealing shop a new form of Siemens annealing furnace is erected, for which great economy is claimed.

The office building is the most forward towards completion of all the buildings, and will be occupied by the staff in the course of a week or so. The next nearest completion is the power house, the smoke stack of which is 200 feet high, and partly built of steel, acting as a landmark to the surrounding country.

The steam engine is nearly set up, and generators are also on the ground ready for erection, steam being expected to be turned on in the course of the next month.

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING JULY 31ST, 1900.		WEEK ENDING JULY 30TH, 1901.	
Adelaide	Value £104	Adelaide	Value £16
Alexandria	32	Amsterdam	90
Amsterdam	110	Buenos Ayres	238
Bombay	45	,, Teleg. wire ..	320
Bremen	230	Calcutta	678
Brussels	27	Cape Town	801
Buenos Ayres	67	,, Teleg. sundries ..	483
,, Teleg. cable ..	700	Chefoo. Teleg. mat.	37
,, Teleg. mat. ..	180	Chinde. Teleg. mat.	122
,, Teleg. wire ..	100	Colombo	60
Calcutta	2,046	Copenhagen. Teleg. mat. ..	33
Cape Town	253	Demerara. Teleg. mat... ..	183
Chinde. Teleg. wire	124	Durban	588
Colombo	50	East London	289
Copenhagen. Teleg. wire ..	100	Flushing	116
Demerara. Teleg. mat.	87	Gottenburg	12
Durban	332	Hong Kong. Teleg. apparatus	40
East London	892	,, Teleg. mat. ..	33
Genoa	21	Lyttleton	82
Hamburg	51	Madras	749
,, Teleg. mat.	500	Malta	246
Hiogo	99	Marseilles. Teleg. mat. ..	145
Hong Kong	24	Melbourne	583
Launceston	46	Ostend	100
Madras	17	Rangoon	40
Malacca	229	Perth	3 5
Malta	303	Port Said	20
New York. 2,459c. Teleg. appar.	—	San Francisco	42
Ostend	350	Shanghai	71
Parana	291	Singapore	47
Perth	60	Sydney	2,429
Port Elizabeth	1,100	,, Telephones	41
Rio Janeiro	830	Valparaiso	74
Rosario. Teleg. mat.	522	Vera Cruz	29
Santos	252	Wellington	225
Shanghai	1 0	,, Teleg. mat. ..	78
Singapore. Teleg. cable machnry.	2,006	,, Telephones ..	1,790
Sydney	548	Yokohama	126
Yokohama	209		
Total ..	£13,117	Total ..	£11,241

Foreign Goods Transhipped.

Cape Town. Elec. wire	Value £1,300	Cologne. Teleph. cable	Value £278
New York. Elec. mat.	380	Durban. Elec. mat.	123
		Gottenburg. Elec. apparatus..	13
		Madras. Elec. car parts ..	76
Total	£1,680	Total ..	£490

Annual Outings.—Messrs. Perry & Co., of 17, Grafton Street, W., had their annual outing on Saturday last, and journeyed to Windsor, some by bicycle and others by rail. Luncheon was served at the hotel, the chair being taken by Mr. Pitt (manager), and vice-chair by Mr. Bridgeman. An enjoyable drive was afterwards arranged to Burnham Beeches, where tea was taken.

Last Saturday week the first annual excursion of the employés of the Renewable Electric Lamp Company, Limited, took place at Southend-on-Sea. The company consisted of over 100 of the employés and some of the staff.

Bankruptcy Proceedings.—The creditors of Chas. Alfred Church, manufacturing electrical engineer and builders' merchant, trading as H. Conolly & Co., at Hampstead Road, met last Friday at the London Bankruptcy Court, when an adjournment of a fortnight was agreed to with a view to the debtor's friends coming forward with a proposal to pay the creditors 20s. in the £ and 4 per cent. interest on the amount of their claims. The debtor denies that he is insolvent, and states that whilst he only owes about £2,500, his estate is worth £12,000 at the least.

Books Received.—"An Introduction to the Practical Use of Logarithms," by F. Glanville Taylor. London: Longmans, Green & Co., 1901. 1s. 6d.

"Great Eastern Railway Company's Tourist Guide to the Continent," edited by Percy Lindley. London: 30, Fleet Street. 6d.

Brunswick Lamps.—We understand that the Brunswick Electric Lamp Company has commenced the manufacture of high efficiency incandescent lamps for high and low voltage at

men would be prepared to subscribe their names if thereby they could learn from the pen of the managing director of

trical profession. It is becoming quite a common practice among municipal authorities and others who own or command electric lighting and power stations to import into

works which have been established at Hoxton, N. The head offices are at 39, Victoria Street, S.W. A list has been issued by the company. A diagram of test shows the 16-c.p. lamp burning only 2·7 watts per candle for about the first 200 hours, this increasing to 3·7 watts at the end of 1,000 hours with a candle-power of just over 11.

Catalogues and Lists.—Messrs. G. Clark & Sons, iron-founders, of Shipley, have placed before us an illustrated catalogue of their specialities in feeder boxes, house services, with internal fittings, &c. It is about five years since the firm decided to lay down special plant for doing electrical ironfoundry work, and they are now supplying many of the leading contractors and municipal electrical undertakings in the kingdom. Views of the different departments of the works are given in the catalogue. A special feature is made of the firm's system of distribution for concentric mains, each box being shown complete with fittings as in actual use. The list contains outline drawings of feeder boxes, two to seven-way mains disconnecting boxes, pilot wires distributors, fuse and cut-out boxes, tramway feeder and junction boxes. The book is very neatly arranged, and we have no doubt will be of service to engineers connected with electricity undertakings.

Messrs. A. G. Beaver & Co., Limited, have sent us a sheet showing a few of their designs of electrical fittings in art metal work.

"Electric Light and Power" is the title of a brochure which has just been brought out by Messrs. Johnson & Phillips, bringing before the trade notice of some of the work executed by them in different parts of the world. The firm claim to be in an exceptional position for carrying out from beginning to end all the work embraced in both lighting and power schemes. Photographic illustrations are given of some of the stations equipped with J. & P. plant, these including Blackheath, Newington, Amberley Road, Regent's Park, Hong Kong, Tunbridge Wells, Bedford, and so on. In electric power work, both continuous and polyphase machinery is represented, showing the application of motor driving to gold mining operations, also pumping, steel works machinery, &c. The list should be interesting to customers of the firm and to others who may contemplate putting down new installations.

Messrs. Wallach Bros., of Gracechurch Street, E.C., have sent us a copy of their Section H. list of novelties such as "Evertrusty" drills, safety boiler alarms, oil filters, metallic tubing, lifting jacks, tachometers, belting, &c.

Dick's Asbestos Company send us a circular of their Eagle non-conducting cement, for covering boilers, pipes, &c., also their asbestos non-conducting covering and asbestos lagging.

The July list of the International Electric Company shows their motor fans, insulation testing set, "thousand-mile" transmitter, miner's lamp, and h.v. fittings.

A pamphlet on "The Progress of Natural Ventilation" has been issued by Messrs. Robert Boyle & Son, Limited, of Holborn Viaduct, with reference to their system.

We have before us an excellent set of catalogues which have been received from Messrs. Frank Suter & Co., Limited, of Berners Street, W. They are devoted to illustrated descriptions of "Helios" electrical machinery and apparatus, which are about to be well brought before tramway and other electrical men in this country. The present five lists are only a few out of a batch of "Helios" catalogues which are now in course of preparation. No. IIB is devoted to overhead material for tramways, No. IIC to the type B.M. brake releasing magnet, No. III. to resistances, regulators and controllers of various types, No. IIIA to controllers of the R.W.S. type, while No. IVc. describes the Helios continuous current enclosed type motors for traction and other work. Useful and instructive diagrams accompany the letterpress, and prices are given of most of the machinery and apparatus detailed. The later lists to which we have referred will deal among other things with three-phase motors, generators and transformers, tramcars and tramcar equipment, arc lamps, cut-outs, switches, multipolar machines, switch gear, &c. We have said sufficient to indicate to electrical engineers that the lists will be worthy of their study.

Church Lighting.—St. Andrew's Church, West Kensington, is being electrically lighted by Mr. Fred Satchwell, M.I.E.E., of Broadway, Walham Green. The fittings are designed by him, and are in wrought-iron; and the screen is also to be most elaborately lighted.

Dust Destructors.—It is reported that experiments made in Zurich with English, German and French refuse destroyers proved the superiority of the English, and as a consequence large orders have been given to a London firm.

Fire.—The directors of the St. Helens Cable Company, Limited, Warrington, ask us to state with reference to the fire which took place at their works on July 26th, that no damage has been done to the machinery, and that work will be resumed immediately the fire insurance people have completed their assessment.

Holidays. — Messrs. Belliss & Morcom, Limited, announce that their works will be closed during Bank Holiday week until August 12th.

Poles.—The *Timber News* of Liverpool says that the United States Department of Agriculture recently issued a report on telegraph, telephone and electric light and power poles, from which it appears that the timbers most used for these purposes are tamarac, white cedar, and red juniper. Their life in the ground is about 10 years, so that every decade sees one generation of poles worn out and another cut to replace it. The total, including the poles required for new lines, is therefore very large, the telegraph lines of the country requiring nearly 600,000 poles annually, at a cost of about £250,000, and the telephone and electric car lines and light systems, it is estimated, use as many more. At the present time the price of poles for such uses varies greatly, ranging from 4s. to £10 each; but with the ever increasing demand the natural supply will run low, and then, says report, higher prices will prevail.

Royal Assent.—The following Acts have received the Royal assent:—

Electric Lighting Order Confirmation Acts, 1901, Nos. 1, 5, 6 and 10.
Notting Hill Electric Lighting Act, 1901.
King's Norton and Northfield Urban District Tramways Act, 1901.
Bexley Tramways Act, 1901.
Cleveland and Durham County Electric Power Act, 1901.
Yorkshire Electric Power Act, 1901.
Derbyshire and Nottinghamshire Electric Power Act, 1901.
Metropolitan Railway Act, 1901.
Shannon Water and Electric Power Act, 1901.

Smoke Prosecutions.—At Westminster last week, says the *Times*, the Westminster Electric Supply Company were summoned by the City Council for failing to comply with the notice requiring them to abate a nuisance caused by black smoke issuing from their chimney shaft. Mr. Strutt supported the summons. Mr. Fowler, for the defence, submitted that for black smoke to issue 14 minutes intermittently in one day was not a nuisance. On the day in question a boiler broke down through one of the tubes bursting, and the engineer had to start another. During the brief time thus occupied it was impossible to prevent black smoke from issuing. Mr. Sheil said he could not accept that. If it had been shown that there was black smoke on one day only, and that this was due to an accidental circumstance, it might have affected his decision. There would be a fine of £10 and 2s. costs.

Mr. Sheil's magisterial hand also came down equally heavily upon Messrs. Mowlem & Burt, of Grosvenor Wharf. It was contended for the defence that the black smoke issued during the process of testing a smoke-consuming apparatus, but Mr. Sheil said that was no defence whatever, and he imposed a fine of £10 and 2s. costs.

Trade Announcements.—Electromotors, Limited, Openshaw, Manchester, have opened a London office at Cornwall Buildings, 35, Queen Victoria Street, and have appointed Mr. G. H. Congdon their sole representative for London and district.

The Accumulator Industries, Limited, notify that their registered offices have been transferred to the works premises at Maybury, Woking, Surrey. The London offices remain as heretofore, 14, Silver Street, Bloomsbury, W.C.

ELECTRIC LIGHT AND POWER NOTES.

Amble.—The D.C. has received notice from the Northern Counties Electricity Supply Company, Limited, of its intention to apply for powers to supply electricity within the district of Amble.

Ashington.—The Northern Counties Electricity Supply Company has given notice of its intention to apply for a prov. order for power to supply electricity in the Ashington district.

Birmingham.—Important work is outlined in the last report of the Electric Supply Committee. It states that owing to the necessity of making provision for the future development of the department, and in view of the probable need for electrical energy for tramway purposes, the Committee purchased the site of the old Birmingham General Hospital, at £23,000, for a generating station. If the ordinary growth of the output continues within the area at present supplied, the existing stations at Water Street and Dale End will be working at their full capacity by the end of 1903, and any extension of the supply, independently of tramway requirements, must therefore be provided for from the new station. The Committee have been informed by the Tramways Committee that it is expected that electrical energy will be required to work about 13 miles of tramway route by January 1st, 1904, and a further 39 miles by January 1st, 1907. The Committee instructed their engineer to prepare plans and to report upon the equipment of a generating station on the old hospital site, Summer Lane, so as to meet the requirements of the tramways department and the probable extension of lighting in the near future. They were informed by him that the erection of a sufficient power station and the instalment of the machinery would take at least two years. There was, therefore, no time for delay in going into the matter. The site upon which it is proposed to erect the necessary buildings has an area of 19,409 square yards, and the ultimate cost of the works when the site is fully utilised is estimated as follows:—Twelve combined engines and dynamos, £79,500; boilers and economisers, £24,000; condensing apparatus, including pumps and exhaust pipes, and pipe connections between canal and pumps, £8,860; steam piping, feed connections, and exhaust arrangements in engine room, £12,000; coal-handling plant, £6,300; water tanks and water-softening plant, £6,100; switchboards, balancers, transformers, and accumulators, £22,300; crane, £1,400; main buildings, including shedding over canal, cooling tanks, &c., £74,500; architect's commission and clerk of works' salary, £4,200; total, £239,220. The whole of the plant with which the station will ultimately be equipped will not be required for some years. For the present it is only proposed to provide for 5,000 H.P., which will supply the necessary energy for the tramway system, and for an extension of lighting mains, as may

are more skilful and careful in their work.

All the machine tools, which are of the most modern and up-to-date English, American, and Continental makes, are to be electrically-driven, the large tools by direct connection to individual motors, and the smaller tools, conveniently grouped, by short lines of shafting. The large 84-in. planers are to be operated by the B.T.H. magnetic clutch drive, which permits the motors to con-

Green & Co., 1901. 1s. 6d.

"Great Eastern Railway Company's Tourist Guide to the Continent," edited by Percy Lindley. London: 30, Fleet Street. 6d.

Brunswick Lamps.—We understand that the Brunswick Electric Lamp Company has commenced the manufacture of high efficiency incandescent lamps for high and low voltage at

be required, to the extent of about 15 miles. The supply of outlying districts, such as Harborne and Bristol Road, will require to be supplemented by subsidiary stations. The engineer estimates the cost of laying the new mains and of the subsidiary power stations at £75,000. To properly work the generating station it will be necessary to practically complete the scheme of buildings, but the machinery can be put down from time to time as needed, and four sets of engines, one-fourth of the boiler equipment, and a portion of the condensing plant will be sufficient as a first instalment of the work. The cost of this work is estimated at £128,890. In order to admit of the Corporation being in a position to work tramways by the beginning of 1904, the equipment of the station must be commenced at the earliest possible date, and the Committee recommend that the Council authorise the carrying out of the first instalment of the work at a cost of £128,890, and the laying of the mains referred to, and the construction of the subsidiary stations, at a cost of £75,000. The matter was to come before the Council on Tuesday.

Brighouse.—The Corporation has received a report prepared by Messrs. Lacey, Clirehugh & Sillar on the present position of the electric lighting undertaking.

Bristol.—The statement of accounts of the electrical undertaking for the year ending March 25th last shows that the number of consumers on March 25th, 1901, was 1,507, being an increase of 292 during the year. The total connections to the mains are equivalent to 119,615 30-watt lamps, as compared with 91,117 at the corresponding period of last year. The number of units sold was 2,191,559, being an increase of 379,048. The use of electric motive power has more than doubled during the year. The gross receipts amounted to £37,398 8s., and the gross expenditure to £25,725 19s. 8d., leaving a gross profit of £11,672 8s. 4d. available towards payment of interest, £7,327 5s. 8d.; repayment of money borrowed, £6,811 11s. 7d.; Avonbank preliminary expenses, £90 11s. 3d.—£14,229 8s. 6d. The credit balance at the commencement of the year was £3,062 3s. 9d., which has met the deficiency on this year's working of £2,557 0s. 2d., and left a balance to carry forward to next year's accounts of £505 3s. 7d. The deficiency on the year's accounts is attributable to the largely increased price of coal during the year (this item alone has increased the cost of generation by over £4,000), to the interest and contribution to the redemption fund for the unremunerative capital at Avonbank, amounting to upwards of £900, and to the management expenses being high, on account of the salaries of members of the staff engaged almost exclusively on new works, being charged to revenue The following statement exhibits the financial position of the undertaking on March 25th, 1901: Total capital expenditure, £293,259 11s. 6d.; mortgage debt, £283,014 10s. 5d.; less paid off or set aside, £36,921 11s. 7d.—£246,092 18s. 10d. Balance at credit of reserve fund, £5,000; balance at credit of depreciation account, £1,390 3s. 1d.

Brynmawr.—The D.C. has received notice that the Electric Supply Corporation, Limited, intend applying during the next session of Parliament for a prov. order, under the Electric Lighting Acts, for powers within the district.

Burnley.—A L.G.B. inquiry was held at Burnley last week into an application by the Corporation for sanction to a loan of £11,000 for electric lighting. It was stated that the Corporation intended to enlarge the present electric lighting station.

Buxton.—The U.D.C. having applied for sanction to borrow £25,000 for purposes of electric lighting, Mr. M. K. North, L.G.B. inspector, held an inquiry last week. Mr. Calvert, electrical engineer, said that last season, with 4,500 lamps connected, they had a load of 126 KW; they had now a load of 285 KW. He impressed upon them the urgency of immediately installing new machinery. There was no opposition. The electric lighting works, opened about a year ago, have already had close upon £25,000 spent upon them.

Croydon and Depreciation.—The conditions under which the electricity supply of the borough was taken in hand are familiar to readers of the ELECTRICAL REVIEW. It is important to quote the following remarks which are made regarding the department by Mr. Frank Brown in his report on his audit of the borough accounts:—

"Nothing has been charged against this department for the clerical and other work done at the Town Hall. A sum of £7,500 has been transferred from the debtor of the revenue account to the creditor of the general district rate account, £5,385 12s. 10d. being for interest, and £2,114 7s 2d. as a sinking fund. I would point out that these are arbitrary amounts. Further, I would bring before your notice that while there is no legal necessity to charge against profits more than interest charges and sinking fund instalments, yet I think the burgesses should have brought before them most clearly that, in my opinion, the depreciation is very much greater than the amount of the sinking fund, and that if instead of the electric lighting being a Corporation department, it had been a company having the privilege of borrowing money at, say, 3 per cent., the trading would, in my opinion, after writing off sufficient depreciation, show a heavy loss."

He also refers to the tramway accounts in connection with the interest received or due from the British Electric Traction Company's instalment of loans, &c. He adds:—

"My remarks as to depreciation in respect of the electric lighting accounts apply to the tramway accounts also."

Durban.—An extensive addition is to be made to the Government's electric works at the Point, which will give a total of 230 arc lamps and 3,400 incandescents of 16 C.P., besides motive power.

East Ham.—Mr. R. L. McCulloch, Woolwich, has been appointed chief clerk in the electricity and tramway department of the Urban District Council.

Eccles.—The T.C. on Monday resolved to apply to the L.G.B. for powers to borrow £20,500 for electric light and traction extension. The extension is in accordance with the scheme of the borough electrical engineer, and the report of Mr. Wordingham.

Epsom.—The U.D.C. has decided to charge 3d. per unit for motive power.

Finchley.—The D.C. has resolved to appoint a resident electrical engineer.

Gwyrfa.—The D.C. has received notice from Mr. Peterson of his intention to renew his application for a prov. order to light the district of Gwyrfa with electricity.

Hastings.—A L.G.B. inquiry was conducted last week by Lieut.-Colonel A. C. Smith, R.E. regarding the application of the Hastings Corporation for sanction to borrow £14,272 for electric lighting mains and machinery.

Leigh.—Upon the advice of the electrical engineer, the T.C. has resolved to apply to the L.G.B. for sanction to borrow the sum of £11,250 for extensions at the electricity works in order to meet the increasing consumption of electricity.

Liverpool.—The Electric Power and Lighting Committee has received the sanction of the L.G.B. to the borrowing by the City Council of £300,000 for purposes connected with the supply of electrical energy.

London.—The County Council has sanctioned an application from the Borough Council of Islington for the borrowing of a sum of £2,500 for mains extensions, and £2,018 for the purchase of electric meters.

Maidstone.—The D.C. has decided to undertake the free wiring of premises subject to a satisfactory agreement with consumers.

Manchester.—The annual report of the Electricity Committee of the Corporation for the year ending March last shows that the number of consumers at the close of the year was 3,790, being an increase of 550 on the previous year. The total number of lamps connected was—incandescent (8-C.P.) 279,860, arc 2,316, as compared with 237,145 and 2,139 respectively. In addition to these there were 672 motors in use, representing 6,560 H.P., being an increase on the preceding year of 172 motors, equivalent to 4,510 H.P. The total output of electricity during the year was 9,639,973 units. The quantity measured and accounted for was 7,944,540, showing a loss of 17·58 per cent. in distribution. There was a surplus on the year's working of £3,515 10s. 6d. This surplus, plus the amount withdrawn from the reserve fund (£484 9s. 6d.), makes up the amount (£4,000) which was paid to the city fund in aid of rates. The following statement exhibits the financial position of the undertaking at March 31st, 1901:—Total capital expenditure, £863,293 1s. 2d.; mortgage debt, £722,273 7s.; amount of mortgages redeemed to date by action of sinking fund, &c, £67,837 13s.; balance at credit of reserve fund account, £13,172 2s. 11d.

Since the appointment of Dr. Kennedy in January of this year to design and equip the Stuart Street generating station and the various sub-stations in connection therewith for the first installation of 15,000 H.P., rapid progress has been made in this direction, and tenders have been accepted for the whole of the engines, generators, boilers, &c., required for this installation. The various contractors are now proceeding with the work, and it is confidently expected that a portion of this plant will be erected and ready to supply current by May 31st, 1902. At the Bloom Street station the iron and steel work of the first pair of boilers, and a portion of the first engine and generator, are now erected in position. Tenders have been obtained to the specifications of the chief engineer (Mr. G. F. Metzger) for the various plant required to complete the equipment of these works, and it is anticipated that one set of generating plant will be in readiness for the output of electricity at the beginning of October, and to assist in meeting the heavy demands for current during next winter. Applications from new customers cannot be considered until the Committee are advised that this station can be made available for next winter's work. Upon the completion of the above work at Stuart Street and Bloom Street stations, the Committee will be in a position to provide the energy required for working most of the tram routes which the Tramways Committee are preparing to work electrically in May next year, and to furnish an efficient supply of current to several of the out districts whose electric lighting orders have been taken over by the Corporation.

Melbourne.—The *British Australasian* says that last year's operations of the municipal electrical works show a gross profit of £11,015, and a net profit of £4,541, the former being less by £1,026 than that earned in the previous 12 months, and the latter slightly less. The capital sunk by the Council is £204,000, and the sinking fund now totals £24,000.

Pontypridd.—The D.C. has decided to resist any application by the Electric Supply Corporation for power to supply electrical energy in the district.

St. Helens.—Mr. W. O. E. Meade-King held an inquiry at St. Helens last week respecting the application by the T.C. for power to borrow £16,500 for the purpose of extending the Cropper's Hill electricity station.

Shannon Power Scheme.—In the House of Commons on July 24th, the Lords' amendments to the Shannon Water and Electric Power Bill were considered and agreed to, together with consequential amendments proposed by the promoters.

Southampton.—At a meeting of the T.C. last week, it was reported that Messrs. Ryde & Sons had advised the Electricity Committee that in their opinion the ratable value of the electric light works should be fixed at £750, and approved of the proposal of the Committee to appeal against the assessment. A conference on the matter had since taken place between the Committee and the Guardians.

Southport.—The yearly abstract of accounts shows that the profits on the gas estate were only £5,583, compared with £10,323 in the previous year. The wider use of electricity is said to have been a factor in decreasing the revenue from gas. The profit on the electricity branch has been £695, against £1,779 in the previous year. The profit estimated was £1,500, there being a deficiency upon the estimated amount of £805.

Stoke.—Negotiations are on foot between the T.C. and the Potteries Electric Traction Company and the North Staffordshire Railway Company regarding the lighting of the town by electricity.

Wales.—It has been decided to light the coming meetings of the Royal Welsh National Eisteddfod at Merthyr Tydvil by electricity. The local electric lighting and traction company will supply the lighting free; the fittings and connections will be carried out by Messrs. Edwards & Armstrong.

Wells.—The B. of T. has revoked the electric light prov. order obtained by the Corporation of Wells in 1896, nothing having been done towards carrying out the works.

West Bromwich.—At a meeting last week the E.L. Committee considered the complaints made by tradesmen respecting the alleged high charges for electricity, and it was decided that for the remainder of the summer season the price should be reduced to 4d. per unit, this being equivalent to a reduction of one-third.

Willesden.—The Electricity Committee has under consideration proposals made by the British Insulated Wire Company and Callender's Cable and Construction Company, Limited, and recommends that the scheme prepared by the electrical engineer be carried out by a company upon satisfactory terms to be arranged. The D.C. agrees.

Wimbledon.—There are now 519 consumers or the equivalent of 32,645 8-c.p. lamps connected with the electricity works. The extensions are proceeding rapidly. The U.D.C. has decided to confer with the Malden U.D.C. as to the lighting of the latter's streets.

Woking.—The D.C. is on the horns of a dilemma, having sealed a contract with the gas company for street lighting while overlooking the fact that the electric supply company's contract for the same purpose does not expire until October, 1902. The latter company owns the lamp standards, which the D.C. has the right to purchase at any time within the duration of the contract; but, on the other hand, the Council cannot interfere with the company's wires inside the standards until the contract expires. The question of a compromise is now under consideration.

ELECTRIC TRACTION NOTES.

Barrow.—The General Purposes Committee has agreed, subject to confirmation by the Council, to lease the Barrow tramways for 26 years to the British Electric Traction Company, on the understanding that the Corporation will have the right of purchase, at the expiration of seven or 14 years from the date of the Board of Trade's certificate authorising the working of the lines by electric traction, for the sum of £19,000.

Birkenhead.—Three more routes of the Birkenhead electric tramways system have been completed and now only await approval by the B. of T. inspector, to be opened for traffic. A fourth route will be ready in a few days. The routes now ready are the Woodside-Higher Tranmere; Woodside-Park Road North; and the Woodside-Park Road South, routes. Woodside is the town terminus by the ferry and railway stations. Forty-four cars have been ordered, and are being supplied by Messrs. G. F. Milnes & Co., Limited. A feature of the cars, which are all "double-deckers," is a "safety" staircase at each end, which has been named the "Birkenhead staircase." The entire system of electric tramways at Birkenhead is expected to be finished and open for traffic before the end of November.

Bradford.—Although the Corporation was not under any obligation to purchase any of the material of the Bradford Tramways Company, in return for the privilege of being permitted to convert the existing lines for electric traction at once, it has agreed to purchase certain depôts and machinery from the company for the sum of £14,128.

Cheltenham.—It is stated that an accident occurred on 29th ult. on the new Cheltenham Light Railway. A tramcar was ascending the steep slope of Cleve Hill and failed to reach the top. It began to run backwards and, the brakes refusing to act, the car gathered tremendous impetus. It safely turned several bends in the road, but at one sharp curve it overturned, and two of the company's workmen, named Jackson and Wells, who tried to jump clear of the car, fell short and were crushed to death. The passengers escaped serious injury.

Darlington.—The Electro-Magnetic Traction Company have brought forward a proposal to instal their new system of surface traction on a small experimental section of line, say a mile or less, for the purpose of demonstrating to the Corporation its practicability and superiority. The proposal of the company includes a guarantee against loss to the Corporation, inasmuch as in the unexpected event of their system not proving satisfactory, they will substitute over the experimental section, without extra cost, an approved method of overhead traction.

Garston.—The U.D.C. is stated to be pushing forward the electric traction scheme in connection with the works which are to be supplied with heat from the destructor. In the event of absorption by Liverpool, the city will have to make terms with the private contractors.

Glasgow.—Our correspondent writes:—"A further consideration of the annual financial statement of the Corporation tramways does not present so favourable an aspect as one would expect on a first glance at the statement. As published recently in your columns the balance amounts to £11,622 6s. The gross capital expenditure since the Corporation took over the system in 1894, and after deducting £153,796 11s. 8d. for depreciation, is £1,793,934 8s. The payment to common good account of £12,500 may be ranked as dividend in this case, although many think this is a cheap rent for the use of the streets, which would require to come out of the funds of a private company. The interest on capital, amounting to £38,979, would also rank as dividend in that consideration also. Adding the net balance, payment to common good and interest on capital we have £63,101 6s., after deducting all working expenses. This would yield 3½ per cent., but if we deduct the common good payment as working expenses we only get 2$\frac{5}{10}$ per cent. as a probable dividend, truly not such a "fat" thing as many have led us to expect. The conversion of the horse to electric system will probably raise this figure to about 11·5 per cent., the percentage of working expenses to revenue working out for horse 82 per cent. and electric cars 46 per cent. During the past year 8,527,568 car-miles were run by horse cars and 1,319,977 by the electric cars, realising on an average per car-mile a revenue of 11·39d for horse and 14·6d. for electric cars. Working expenses per car-mile work out for electric 6·62d., for horse, 9·44d. The net receipts are thus 7·98d. for electric against 1·95d. for horse car system, or as 4 to 1, which confirms the probable percentage given above. Number of passengers carried totalled 132,557,724 persons."

Last week a further batch of some 250 horses were disposed of, the average price being about £21. Several horses were purchased by the War Office authorities for remount purposes. There are some 1,200 horses still to dispose of, and since the commencement of these sales some £60,000 has been received. With the reduction of hours to nine per day, and increase in the number of routes, there are a larger number of men required, but as yet no difficulty has occurred in procuring suitable men. A rather alarming accident occurred at the Cross last week, which, but for the early hour, 7 a.m., might have been serious. One of a number of National Telephone Company's overhead telephone wires fell and came in contact with the live wire of the tramway system, and immediately fused. This in turn caused over 30 other wires to follow suit. The loose wires were cut down by the police before the heavy traffic had commenced.

The last of the horse cars disappeared from the streets on Saturday last, the last route to receive electric cars being Ibrox to Parkhead. The new service was successfully, but unofficially, started on this route on Sunday morning last.

Italy.—It is announced from Naples, says the *Financial Times*, that the construction has now been commenced of an electric tramway from Naples to the cable or rope railway leading to the crater of Vesuvius. By this means one of the difficulties in connection with a journey of pleasure in Italy will be overcome, as it is at present necessary to ride in carriages a distance of 11 miles, on rising ground, having a difference in level of 700 metres, so as to be able to reach the foot of the cable railway. The new electric tramway, which is said to be due to the enterprise of Messrs. Thomas Cook & Son, of London, will have a connection in Resina with the electric line from Naples to Resina, and is being built according to the plans of Engineer Strub, whose scheme is reported to be the most satisfactory of the many projects brought forward in recent years to accomplish the object in question. It is expected that the new electric line will be opened for traffic in the ensuing spring.

Leicester.—The Tramways Committee has now approved an arrangement for the purchase of the local tramways for a sum of £134,000. The Corporation will probably not take over the actual working of the tramways until the end of the year. The present horse cars will be superseded by trolley cars at an estimated cost of £350,000. In the meantime, the preliminary work of surveys, &c., will be rapidly pushed forward, in order that the Corporation Bill may be lodged in the Private Bill Office in November, so as to ensure its passage through the House early next session.

Nelson.—The T.C. has resolved that the reconstruction and electrical equipment of the Nelson section of the tramways be entrusted to the Burnley Corporation, under the supervision of the electrical engineer of the Nelson Corporation.

Northampton.—The T.C. has decided to purchase the tramways for £37,500. This was the exact sum offered by the Corporation for the undertaking two years ago. The offer was finally rejected by the tramway company last April, and the Council immediately decided to acquire the undertaking by arbitration. The company subsequently offered to accept the Corporation's terms.

Oldham.—On Wednesday last week the first serious mishap in connection with the Oldham electrical tramway system occurred on the Middleton Road section. At the top portion there is a very steep gradient, the incline being 1 in 11. It was on this portion of the line that a double-deck car weighing about 15 tons ran away owing to the greasy state of the rails. The driver applied the brakes, and they acted perfectly, so far as preventing the wheels from revolving, but the wheels failed to grip the rails, and the car dashed down the hill at a great speed. The car was slackening its pace on the level, but when going about six miles an hour it struck the rear of a lurry standing on the loop line and jammed it between the car and one of the poles supporting the overhead equipment. The arm of the post was broken. As the Corporation are at present short of cars, there may not be any service on this section for a few days until the car is repaired.

Scarborough.—Application has been made to the T.C. by certain gentlemen who are prepared to promote an electric tramway scheme for the town. The Corporation is already pledged to a Tramways Bill. An expert is to advise the Corporation.

Southampton.—The T.C. have adopted a recommendation that power be sought for, by means of a provisional order, to make certain new tramways. The report of the borough treasurer on the tramway undertaking for the year ended March 31st shows that the total income amounted to £34,178 18s. 8d., and the expenditure to £22,238 15s. 3d., leaving a gross profit for the year of £11,940 3s. 5d., and a net profit of £7,021 11s. 2d. He recommended the Committee to consider the advisability of making further provision for depreciation.

Stroud.—A special meeting of the D.C. to consider the matter of Mr. Nevins's scheme was held on Wednesday last week. The Council at first objected to the 4 ft. 8½ in. gauge as being too wide, but Mr. Nevins said that unless that width was accepted, he should not touch the scheme. The Council gave way, and unanimously approved of the proposed railway connecting Stroud with the neighbouring towns of Painswick, Chalford, Nailsworth and Stonehouse, provided satisfactory details can be arranged.

West Middlesex.—The Light Railway Commissioners continued their inquiry on Monday into the light railway scheme of the London United Tramways, the County Council scheme having been rejected at the previous sitting. The oppositions of the L. & S.W. Railway and of the Heston-Isleworth and Sunbury Urban District Councils, and of several frontagers, were withdrawn on terms being come to, and the only opposers were now the Middlesex County Council and the Metropolitan District Railway Company. Mr. J. Clifton Robinson gave further details of the company's proposals, including additional widenings, estimated to cost £55,000, the original estimate being £177,000. Mr. Littler, K.C., chairman of the Middlesex County Council, appeared for the Metropolitan District Railway, and desired to call Mr. Chas. T. Yerkes, who would pledge his company to carry out a tramway scheme when his railway had been converted to electric traction, but he was not allowed to give evidence.—Lord Jersey, chairman of the Commission, said that the alterations made in those parts of the scheme relating to Hampton, Sunbury, Hanworth, Heston and Southall were so great that they could not be passed until property owners had been duly notified, but the rest of the scheme, eight miles in length, was sanctioned. The approved lines are situate in the parishes of Heston, Isleworth, Hanworth, Teddington and Twickenham. The company will proceed on another occasion with the rejected portion, and will abide by their agreements made with the local authorities. In view of adverse Press criticism the Middlesex County Council has decided to consider all future tramway and light railway matters in committee.

Wimbledon.—An animated discussion took place at the U.D.C. on the motion for the surveyor to prepare plans for the Council's new "comprehensive" tramway scheme. Views were expressed that it would be better to wait till the Council was approached by some company or the London County Council, and various local objections were raised as to the route. Ultimately the motion was negatived. This is the second time the Council has promoted a tramway scheme, and withdrawn its proposals in face of opposition, mostly from North Wimbledon. In South Wimbledon, however, a public meeting has been held in support of the Council's scheme.

TELEGRAPH AND TELEPHONE NOTES.

Ascension and Sierra Leone Cable.—The *Times* abstracts a Parliamentary paper which has been issued containing a copy of an agreement made June 22nd, 1901, between his Majesty's Government and the Eastern Telegraph Company, Limited, for the construction, maintenance, and working of a submarine cable between Sierra Leone and Ascension; together with a copy of the Treasury minute thereon, dated June 23rd, 1901. The Treasury are to pay the company during the term of 20 years from the opening of the line an annual subsidy or yearly sum of £4,500 on certain specified terms and conditions. The rates to the public per word are to be through rates between the United Kingdom and Ascension, 3s. 6d.; between the United Kingdom and St. Helena, 3s. 6d. Local rates between Ascension and Sierra Leone, 1s.; between Sierra Leone and Cape Town, 3s.; between Sierra Leone and St. Helena, 2s.

Cable Communications Committee.—A meeting of this committee was held on 25th ult., when evidence was given by Mr. W. H. Mercer, Crown Agent for the Colonies.

The Cape-Australia Cable.—Under the heading "The State and Submarine Cables," Mr. William Blanchard writes to the *Morning Post* as follows:—"May I be allowed to express a sincere sympathy with the efforts which are being made by Sir Edward Sassoon with the object of securing to the State the right to purchase the Cape-to-Australia Submarine Telegraph Cable? I believe I am right in saying that precedents for this course, relating to concessions which have been granted to submarine cable companies, may be found in the records of several foreign States. About six years ago the Brazilian Parliament decided to acquire by purchase the submarine cables which traversed their territorial limits. This proposal, however, was not then carried out in consequence of the enormous sum it would have added to the national expenditure. Personally, I am in favour of the State acquiring by purchase some of the more important cable sections, especially those which by their location are likely to be useful for military purposes. As this is admittedly a wide question I do not propose to trouble your readers now with the reasons which could be urged in its support. But with regard to the object aimed at by Sir Edward Sassoon, I think the Colonial Secretary would do well to keep in view the possibilities of the future, and I would therefore venture to suggest that immediate steps be taken to safeguard the public interest in such an effective way as to make it impossible for any telegraph cable "combine" hereafter to dictate terms of settlement (in the event of reversion to the State) which shall be burdensome to the taxpayer. Those who are interested in this subject ought not to have forgotten the enormous excess over the original estimate paid by the country for the British inland system of overhead telegraph wires. The late Frank Ives Scudamore assured Parliament that he was prepared to carry out the scheme (which was supported by Mr. Gladstone) at a cost of £2,500,000. Yet the country, on the completion of the transfer to the State in 1870 of the then existing telegraph interests, found itself saddled with a charge amounting to over £7,000,000. Is not this a lesson and a warning?"

Dundee Telephones.—A sub-committee has been to Glasgow to report upon the municipal telephone system of that city, and has now recommended that the advantages of municipalisation be seriously considered at Dundee. A Manchester firm of telephone engineers has offered to carry out a scheme if municipalisation is not decided upon.

Glasgow Telephones.—A Glasgow paper says that the Corporation Telephone Exchange in Renfield Street, which has been in partial use for several months, is now almost completed. The formal opening will take place a month hence.

The Pacific Cable.—New York *Science* states that Mr. Abraham E. Smith, U.S. Consul at Victoria, writes to the Department of State that a surveying party has located the landing site of the British Pacific telegraph cable (which is to connect the Dominion of Canada with the Australian Confederation) on Kelp Bay, near Banfield Creek, 7 miles from the entrance to Barclay Sound, and something over 100 miles from Victoria. The location is described as admirably adapted for the purpose—a good harbour, 12 fathoms of water close to the shore, so that vessels of 10,000 tons can find safe anchorage. The harbour is landlocked, and has a bottom of ooze that it is said will furnish good protection for the wire.

The House of Commons on Tuesday night went into Committee on the resolution that it was expedient to make provision for the construction and working of a Pacific cable and to authorise the issue out of the Consolidated Fund of such sums not exceeding £2,000,000 as might be required for such purpose. After a long encounter with the Irish members, who endeavoured to block the matter because the contract had been given without the question being brought before the House, the resolution was passed by a majority of 114. On Wednesday night there was a further debate, and the Bill was brought up and read a first time. It is stated that to-night the Government is to be interrogated with reference "to the announced postponement of the construction" of the cable.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Para-Maranham	March 1, 1900	
Basseterre-Les Saintes	June 29, 1901	
San Domingo-Curaçao	July 12, 1901	July 29
Anjer-Kalianda	July 30, 1901	
Trinidad-Demerara	July 30, 1901	
Landlines:—		
Cayenne-Pinheiro	April 20, 1901	
Pekin-Kalgan	June 14, 1900	
Maimatchin-Kalgan	June 30, 1900	

Turkish Telegraphs.—The *Levant Herald* states that the Turkish Telegraph Administration has been granted a credit of 335,214 piastres for the construction of a line in the province of Yemen to join at Jeddah the Hedjaz system. The works began a few days ago at Lehia, the Yemen end of the line. The distance between Lehia and Jeddah is 1,045 kilometres.

(Continued on page 195.)

ascending the steep slope of Cleve Hill and linked to

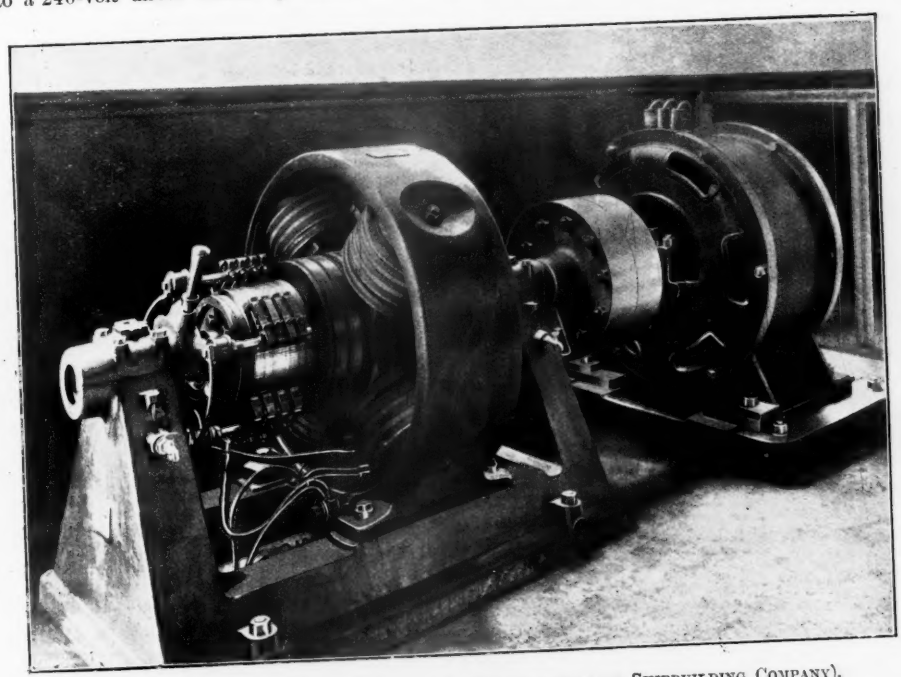
ELECTRIC POWER SUPPLY ON TYNESIDE.

(*Concluded from page* 110.)

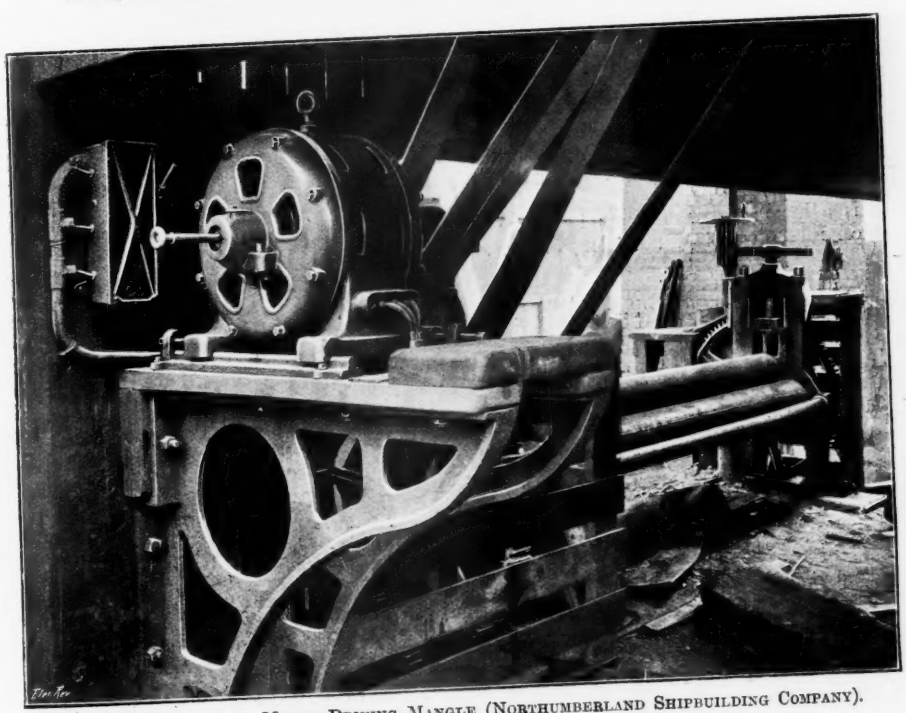
Messrs. The Northumberland Shipbuilding Company's Works.

Sub-station.—Motor-generator of 75 KW., supplied by Messrs. Richardsons, Westgarth & Co., manufactured by Brown-Boveri. This set consists of an asynchronous motor coupled direct to a 240-volt direct current generator. All pressure switchboard—four three-phase circuit panels, one three-phase motor-generator panel, one direct-current motor-generator panel, and two lighting circuit panels. Transformers, by Messrs. The British Electric Transformer Manufacturing Company—four 75-KW. single-phase (ratio 5,500 to 440 volts), three in use and one spare. The efficiency at full load is not less than 97·9 per cent.

Motors.—Messrs. The British Thomson-Houston Company's three-phase induction type.



75 KW. Brown-Boveri Motor-Generator (Northumberland Shipbuilding Company).



7½-H.P. Three-phase Motor Driving Mangle (Northumberland Shipbuilding Company).

The switchboards were supplied by Messrs. The British Thomson-Houston Company, Limited. High pressure switchboard—three feeder and three transformer panels—the former each equipped with three fuses and a triple-pole oil-break switch, the latter with high and low pressure fuses. Low

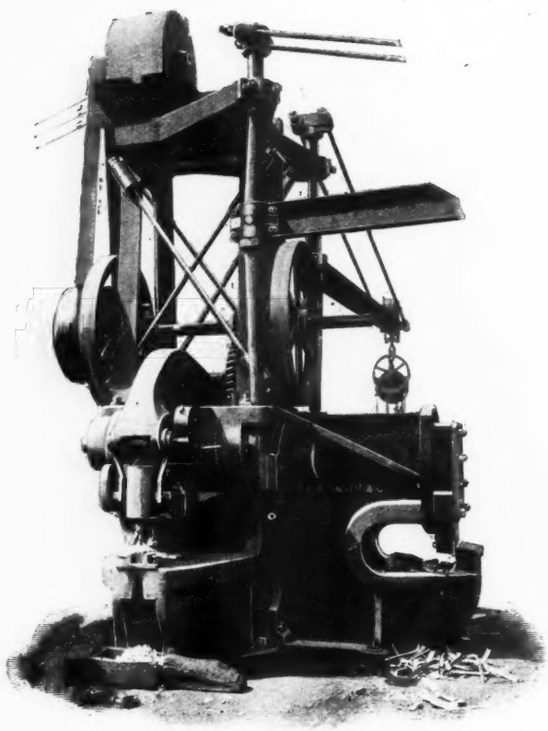
Winches.—Eight, spur driven, with Messrs. The British Thomson-Houston Company's electrical equipment, consisting of a three-phase induction motor with controlling gear and resistances. The whole gear is totally enclosed by sheet-iron covers. Each winch is capable of lifting 3 tons at 50 ft. per

Sierra Leone and Ascension; together with a copy of the Treasury

(Continued on page 195.)

minute, and of running in either direction at varying speeds, all motions being controlled by one handle. The cables to the various winches are laid underground in wood troughing, and run in with bitumen to guard against injury.

Lighting.—Arranged on the 240-volt two-wire system; consists of 50 arcs and about 250 incandescent lamps. The arcs are of Messrs. The British Thomson-Houston Company's enclosed type, run two in series.



Motor-driven Punching and Shearing Machine (Northumberland Shipbuilding Company).

All the plant in the yards was erected by Messrs. The British Thomson-Houston Company, Limited.

The accompanying illustrations serve to show the manner in which the sub-stations are equipped, and the various machines adapted to electrical driving.

The following is a list of the contractors by whom the work has been carried out, and of the staffs of the two companies:—

The Newcastle-upon-Tyne Electric Supply Company, Limited.

Neptune Bank Power Station.

Steel work of buildings ...	The Darlington Wagon and Engineering Company.
Traveller	Jos. Booth & Bros., Ltd., Rodley.
Engines for direct current sets	Belliss & Morcom, Limited, Birmingham.
Main engines, one by	The Wallsend Slipway and Engineering Company, Limited.
„ three by ...	Wigham Richardson & Co., Ltd., Walker-on-Tyne.
Boilers, steam and feed piping, stokers, self-supporting steel chimney	Babcock & Wilcox, Ltd., London.
Circulating and spray pipes, exhaust piping	Körting Bros., London.
Continuous current generators and exciters, three-phase alternators	The British Thomson-Houston Company, Limited, London.
Motor-generator	Richardsons, Westgarth & Co., Ltd., Hartlepool (Brown, Boveri and Co).
Motor equipment of generating station	Bruce Peebles & Co., Edinburgh
Low pressure switchboards ...	A. Reyrolle & Co., Ltd., London.
High pressure switchboard ...	S. Z. de Ferranti, Ltd., Hollinwood.

Outside System.

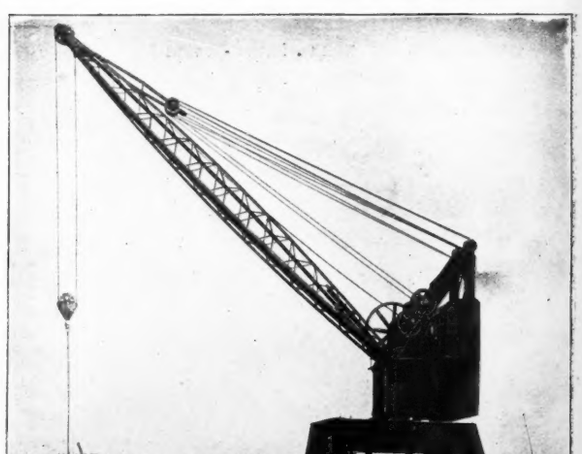
High pressure cables	Callender's Cable and Construction Company, Limited, London. The British Insulated Wire Company, Limited, Prescot.
Low pressure cables	Callender's Cable and Construction Company, Limited.

Sub-Station.

Motor-generators	Richardsons, Westgarth & Co., Limited (Brown, Boveri & Co.). The British Thomson-Houston Company, Limited.
Low pressure switchboard ...	A. Reyrolle & Co., Limited.
High pressure switchboard ...	Richardsons, Westgarth & Co., Limited (Brown, Boveri & Co.).
Ironwork and buildings ...	The Clyde Structural Iron Co., Limited, Glasgow. W. T. Wier, Howden-upon-Tyne.
Cranes	Jos. Booth & Bros., Limited.

The Walker and Wallsend Union Gas Company.

Motor-generators for different works	The British Thomson-Houston Company, Limited. Richardsons, Westgarth & Co., Limited.
High pressure switchboards for different works	S. Z. de Ferranti, Limited, Hollinwood. Richardsons, Westgarth & Co., Limited. The British Thomson-Houston Company, Limited.
Low pressure switchboards for different works	The British Thomson-Houston Company, Limited, and A. Reyrolle & Co, Limited.
Complete equipment of works	The British Thomson-Houston Company, Limited.
Motor equipment in different works	The British Thomson-Houston Company, Limited. The British Westinghouse Electric and Manufacturing Company, Limited. Richardsons, Westgarth & Co., Limited.
High-pressure cables	Callender's Cable and Construction Company, Limited, London.
Low-pressure cables	Callender's Cable and Construction Company, Limited, London.



20-ton 3-motor Electric Crane (North-Eastern Marine Engineering Company).

List of Officials.

The Newcastle-on-Tyne Electric Supply Company, Limited.

General manager	J. S. Watson.
Secretary	M. Short.
Resident engineer for construction of Neptune Bank power station	H. L. Riseley.
Architects for power station buildings	Sandeman & Moncrieff.

The Walker and Wallsend Union Gas Company.

General manager and engineer	A. B. Walker.
Secretary	C. H. Armstrong.
Consulting engineer for both schemes	Charles H. Merz, of Newcastle-on Tyne and London.

switch, the latter with high and low pressure fuses. Low

covers. Each winch is capable of lifting 3 tons at 50 ft. per

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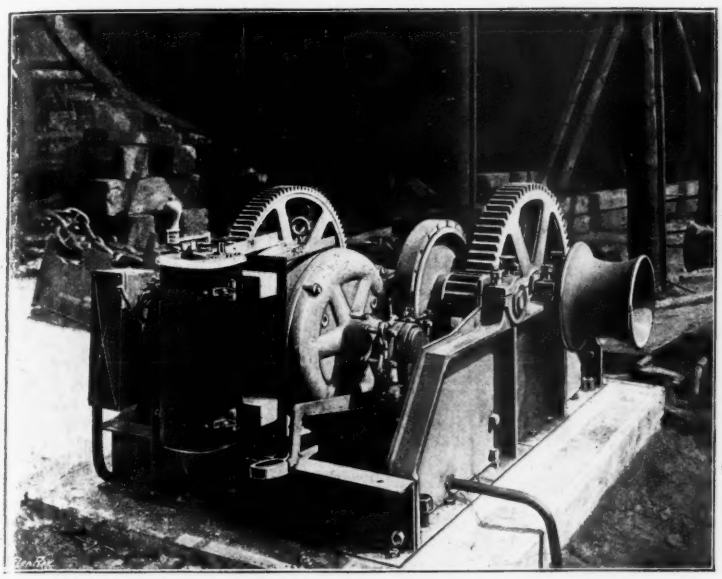
We are indebted to Mr. Merz for the particulars and photographs embodied in the foregoing description of the undertaking; our thanks are also due to Mr. J. S. Watson for kind assistance in the preparation of the article, and to Mr. Wm. McLellan for his courtesy in conducting us over the works and explaining the various arrangements on the occasion of our visit to Tyneside.



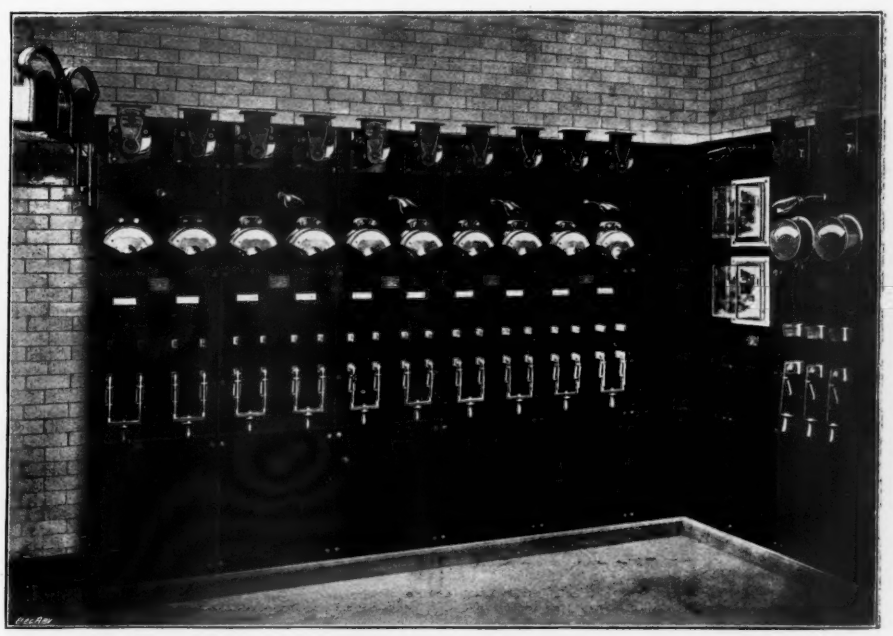
Tyneside: Three-phase 3-ton Winch with Cover off. (Northumberland Shipbuilding Company).

LITERÆ HUMANIORES.

To make the assertion that a mere man of science may be, and frequently is, "an insipid pedantic character, and ridiculous" in a journal which apppeals primarily to men of scientific education, will possibly appear a wanton insult to our readers. The accusation, however, is by no means warranted; we stand behind no one in admiration of brain power, and our sympathies naturally lead us to admire most of all that development of brain power which is made manifest in the explorer of nature's secrets. But at the same time it cannot be disputed that the man of science must always rank below the statesman as a benefactor to his species, and so we arrive at a conception of the ideal hero as the individual who, combining political with so-called scientific knowledge, shall be competent to remove abuses without putting others in their place, and who shall leave the world better to live in than it was before his birth.

In the present state of civilisation, and in such a land as Great Britain, the highest post to which the ambition of man can aspire is that of Prime Minister, or leading member of the Cabinet; while to those of us who must always be restricted to a lower grade of the national hierarchy, the positions of similar importance and respectability are general managerships or active directorships in large manufacturing and commercial enterprises, where we shall have the control of capital, brains, and labour. But it were idle to assert that the profoundest and most lengthy study of any department of science—or, indeed, of any number of such departments—alone will ever fit a man to adorn a position of heavy commercial responsibility, unless he happen to be one of those "sports" who possess at birth a genius for finance.

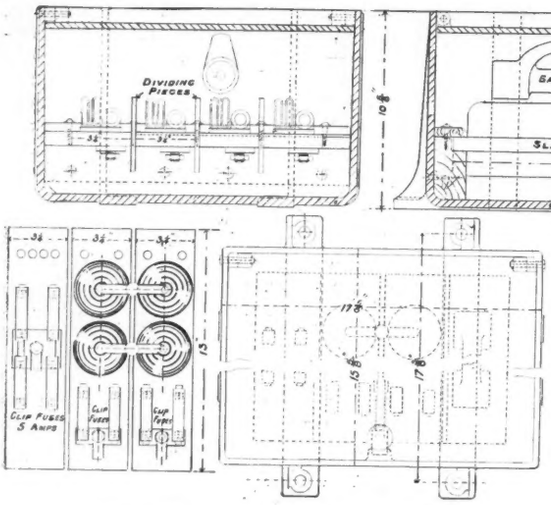
Some years ago we remember hearing a highly successful commercialist quote the saying to the technical manager of his works, that while "any fool can make a thing, it takes a man to sell it." This observation may, perhaps, appear to be simply of a splenetic nature, to be entirely *ex parte*, to be wholly devoid of justice. A little reflection, however, or a little knowledge of the world, will show that it conceals much truth as well as much error; so much truth, in fact, that the lesson it conveys is worthy of most careful attention. We have already urged that qualitative (*i.e.*, non-mathematical) work and pure mathematics are each useless to the man of science; that they should be regarded as the two inseparable halves of the quantitative or mathematical whole; but we have admitted that the former alone will often enable a man to earn his living as another man's subordinate. In a precisely similar fashion, looking at the matter from a wider standpoint, commercial ability and quantitative scientific knowledge are each useless to the man of the world; they are the two halves of the statesman-like whole; yet the former alone will enable a man to earn his living in a position of considerable affluence, but in one which we are pleased to consider as intellectually and reputably inferior.



Tyneside: Switchboard in Distributing Station. (North-Eastern Marine Engineering Company).

It is an undoubted fact that even the best kind of scientific education does not necessarily make for commercial ability. To the man of science himself this fact is mysterious—the very secret of commercial ability is elusive. He often finds business men earning three or four times his own income, impressing their neighbours with a far higher

sense of their importance than he is able to do; men who, in all respects save one, are emphatically his inferiors. Before we can ascertain why a scientific education does not foster commercial ability, therefore, we have to attempt an analysis of this quality; to see why there is always that kind

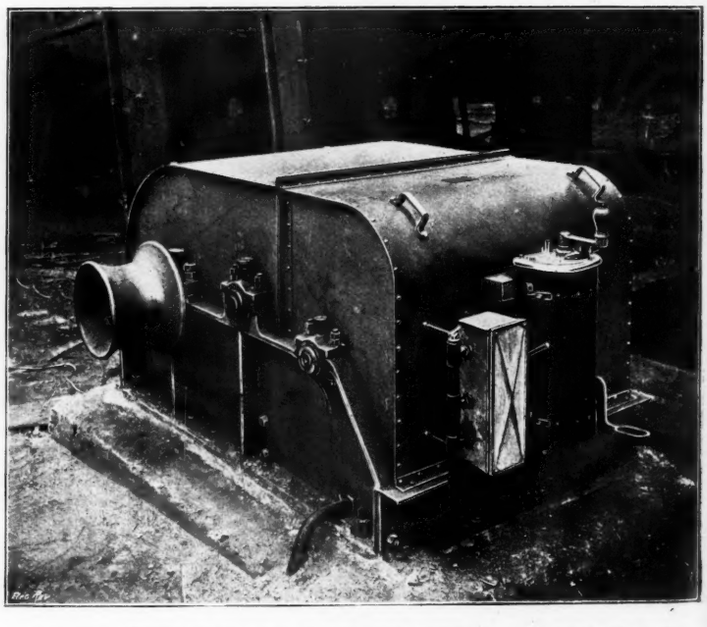


Details of Distribution Boxes used in Works.

of freemasonry of confidence among capitalists to which the expert is seldom admitted. Commercial ability seems to be a rule-of-thumb, or intuitive knowledge of mankind, an unsystematic variety of non-biological anthropology, an acquaintance with men and cities. Commercial ability is the power of impressing an interlocutor with the notion that the speaker is truthful, responsible, and skilful; it involves an instantaneous evaluation of the mental calibre of the interlocutor, a rapid appraisement of his habits of thought, intelligence, and sympathies—maybe of his foibles, prejudices, and ignorance. It requires certain histrionic qualities to enable the salesman to respond to the buyer's temperament; to be facetious if he is jocular, intimate if he is familiar, solemn if he is deficient in humour, to be all things to all men. The student of science has to deal with plain facts and things, which present to him always the same face, not smiling to-day, and frowning to-morrow; or which cover their face with the same veil of obscurity, not feigning eagerness to-day and coyness to-morrow. The man of science is like the golfer playing "bogey;" he pits his skill against fate or the law of averages. The man of commerce resembles the golfer in a match competing against a rival of unknown skill; or the whist player with a fallible partner and fallible opponents. To take another metaphor, which carries its own lesson, we may say that the man of science is like the anatomist performing an operation on the dead body which lies always passive beneath his knife; the man of commerce is carrying out vivisection, and is dependent upon his skill in providing anæsthetics to avoid a fatal mistake.

We have not stopped to labour the fact of scientific education being alone insufficient to equip the man of the world, for it is so painfully obvious. Most of us know men of prodigious depth of mind with very narrow views, men who are unique in the laboratory, who can grasp the scientific bearings of a problem in no time; men who are helpless outside the laboratory, who cannot devise manufacturing processes, to whom the workman is impossible. We also know men who easily control a yard full of labourers or a shop full of mechanics; men who fail to govern an office of clerks and draughtsmen, who cannot get on with their equals, and who quail before the board of pompous directors. The first is the insipid pedant who has not studied his fellow creatures, and who has no appreciation of money matters. The second is the man who has travelled far but not yet attained the fulness of the Pauline dictum. The first must always remain in the laboratory, beneath the second in responsibility, dignity, and remuneration; the second can never emerge from his position of subordination to the ultimate employer and man of the world.

In such circumstances as we have attempted to sketch, it follows that the primary end of education is to teach knowledge of mankind, acquaintance with the powers and limitations of the species, an unerring judgment in moments of critical import; and this is true whether the student be finally intended to become expert, politician, or accomplished man of leisure. But as man can only learn by experience, the word "teach," in our last sentence, is not strictly applicable to the case in hand, and we should say that the primary end of education is to promote or stimulate the growth of intellect in such a direction that the student may be able to acquire knowledge of mankind more easily and rapidly than he does by nature. This, we argue, cannot be done by mathematical processes, nor by exclusive attention to mathematics, for that tends to a sort of mental self-sufficiency which is sometimes lamentable in its effects. It cannot be done by a purely classical education, if by "classics" we understand simply Latin and Greek, and if we regard the authors read, as teachers of elegant and correct diction or of rhetoric only. It can be done, so far as we can achieve anything completely in this world of compromise, by an education in the "humanities," to use the old Scotch word: by reading Homer, Virgil, Cicero, &c., as text-books of human nature, by reading ancient, medieval, and modern history in order to see the difficulties our predecessors had to encounter, how they surmounted them, what mistakes they made in the process, and how we suffer or benefit from their errors or triumphs. A sound knowledge of history, and of the collective lessons to be learnt therefrom, often called social and political economy, will save us from many absurdities and embarrassments, which no command of mathematics can ever guard us against; in technical directions it will prevent our inventing and waxing eloquent over a device that was patented and proved useless a score of years ago; in more general directions it will warn us from the dangers which lurk in extreme opinions of all kinds. Apart from the



Tyneside: Three-phase 3-ton Winch with Cover on. (Northumberland Shipbuilding Company.)

intrinsic merit of history, extrinsically it teaches that we had ancestors who failed in the battle of life, or succeeded with a success little better than failure; it shows that man is not omnipotent, and indicates the fatuity of that conceit and unbridled ambition now denominated "hustle." It teaches that what we call the "power" of the species is limited; that if we emit more than so many foot-pounds of energy—be it muscular or be it nervous—per diem, collapse is inevitable. It shows no surprise at the periodical inflations and absolutely consequent panics of the stock markets. It simply demonstrates that each crest of mental or pecuniary delirium must be followed by the trough of pecuniary or mental syncope. It proves that the phenomena of Wall Street are pathological, not physiological, symptoms. All the various subjects included in the humanities are pertinent to the student of science, extrinsically, if not intrinsically, for they broaden the mind, and by exercising it increase its capacity and logical power. In art, painting, sculpture, music, in pure literature, in poetry, in the dead languages, in every single department of knowledge there is something to be learnt; something which one day may be positively valuable to the man of science, something which assuredly will be valuable to him always as having formed a change in the tedious business of learning how to learn, as having formed an intellectual excursion.

We therefore regard the higher mathematics as precisely equal in importance to all the sciences a man has to study, except the one on which he is to be a recognised expert. We regard a training in those subjects as part of the final specialisation of the educational course. And we desire to postpone that specialisation to the latest possible moment. Assuming, for the sake of argument, that a well-educated youth who is to become a professional electrician can acquire a sufficiently deep knowledge of electricity and the "side lines" of physics, chemistry, and mathematics by four years' steady application, we urge that until the last four or five years before he must begin to earn his living, he be educated simply in the humanities, and that his education be conducted on exactly parallel lines to those adopted in the case of cultured men of ease. We have found one other branch of training so eminently useful to the man of science (because, as we have pointed out, he is so commonly deficient in that knowledge), that we should like to insist upon it also. At some period of the youth's career, preferably, perhaps, just before he begins to specialise, he should serve for a year in some merchant's office as a clerk, not paying a premium for admission, but receiving the salary to which his services entitle him, neither more nor less than what he would receive were he intending to remain a clerk all his life. It probably does not matter much what the business is so long as it is well, smartly, and remuneratively conducted; we doubt if there would be much practical advantage in preferring an engineer's office to a bank, or a bank before a wholesale draper's. The great idea of this diversion from ordinary scientific training is to teach the youth business habits, punctuality, conciseness in correspondence, the value of time and money, and a knowledge of mankind.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 190.)

The Telephone Service.—In the House of Commons on 26th ult., Mr. Austen Chamberlain said that it was hoped to begin the connection of subscribers in October with the central exchange, which will serve the City and a considerable district to the West, and in the course of the autumn or early next year exchanges at Westminster, Kensington, to Chiswick, Putney, Wimbledon, Kingston, and Richmond will become available for use. The Postmaster-General is not in a position to name definite dates for the extension of the system to the various districts of East London. It was stated that the rates of subscription will be announced as soon as subscribers can be invited to join the system.

Tunbridge Wells Telephones. — The municipal telephone system was inaugurated on Saturday afternoon last by the Lord Mayor of London. The new system provides an unlimited service for £5 7s. 6d. a year. The new system enables the whole of the villages around Tunbridge Wells to be in telephonic touch with each other, and communication with the Post Office trunk lines is available without extra charge to the subscribers. The exact area already covered by the municipal system is 220 sq. miles. The Lord Mayor, in declaring the system open, said he did not entertain for one moment the slightest doubt that what they had done in Tunbridge Wells would be speedily copied by all municipalities throughout the country.

Wireless Telegraphy.—It is stated in the *Times* that in the French naval manœuvres wireless telegraphy was much used, and the greatest secrecy is preserved as to the results, but the navy is somewhat in a state of expectancy, and the system cannot yet be considered as assuring a general means of communication.

Yorkshire Villages and Telegraph Communication.—We read in the *Times* that the Postmaster-General has initiated in Yorkshire an experimental scheme for establishing telegraphic communication for the villages during the night. Hitherto villages which have had the means of telegraphing during the day have not had at night, even in emergency cases, such as a great disaster, the opportunity of wiring to the larger places. Now, with the co-operation of postmasters in the North-Eastern District, there are to be in the villages emergency calls with York, Doncaster, Goole, Selby, Malton, and Driffield, and parish councils are to be called upon to pay 10s. a year for the apparatus, ordinary telegraph charges and late fees being levied on the senders of messages. The experiment is interesting, and likely to meet an obvious want.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 2nd. H.M. Consul at Amsterdam states that tenders are invited by the Municipality of Amsterdam for the supply of "electrical tram-carriages arranged for above-ground supply of electricity, and for about 5,000 tons of grooved rails for tramways, with necessary appurtenances." Particulars may be obtained from the Director of the Municipal Tramways, Nieuwe Achtergracht, No. 164, Amsterdam.

Brecon.—August 5th. Tenders are invited for electrically lighting the Brecon and Radnor Joint Asylum now erecting at Talgarth. See "Official Notices" June 28th.

Cardiff.—August 6th. The Corporation wants tenders for double-deck bogie cars, four-wheel cars, and single-deck bogie cars; also for switchboard, with instruments. See "Official Notices" July 19th.

Christiania.—August 12th. Tenders are invited by the Norwegian Government for battery zinc, conducting wires, soldering tin, sal-ammoniac, and signboard shields for the Telegraphs Administration. Specifications, &c., may be inspected daily at the office of the Controller of Material, Kongens Gade 21, Christiania.

Croydon.—August 26th. The electric wiring and fitting of the Lunatic Asylum, Warlingham, Surrey. See "Official Notices" to-day.

Darlington.—August 22nd. Lancashire boiler, 350 H.P. engine and C.C. dynamo, and steam, &c., piping, for electricity works extensions. See "Official Notices" to-day.

Doncaster.—August 17th. The Corporation wants tenders for cables and wires for tramway feeders, also feeder and section pillars. See "Official Notices" to-day.

Dundee.—August 5th. The Gas Commissioners want tenders for condensing and cooling plant, electrically and steam driven pumps, feed heaters, &c., for the electricity works. See "Official Notices" July 12th.

Farnworth.—August 12th. The U.D.C. wants tenders for a car shed traverser. See "Official Notices" July 26th.

France.—August 12th. Tenders are being invited until August 12th, by the French Ministry of Post and Telegraphs in Paris, for the supply of a large quantity of lead-covered telephone cable with 21 conductors. Tenders to be sent to Le Serio-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Glamorgan.—August 24th. For the lighting by electricity of Parc Gwyllt Asylum, near Bridgend. See "Official Notices" to-day.

Grays Thurrock.—August 8th. The U.D.C. wants tenders for electricity meters, and demand indicators. See "Official Notices" to-day.

Heckmondwike.—August 2nd. The Lighting Committee wants proposals from those willing to carry out installation work on the "free or assisted wiring system." See "Official Notices" July 26th.

Manchester.—August 7th. The Electricity Committee wants tenders for 70 feeder and section pillars for the tramways. See "Official Notices" July 19th.

Manchester.—August 14th. The Electricity Committee wants tenders for H.T. switchboards, exciter and auxiliary switchboards for the Stuart Street generating station, also high and low tension boards for sub-stations. See our "Official Notices" July 12th.

Mansfield.—September 5th. Refuse destructors for the E.L. Committee. See "Official Notices" to-day.

Middlesbrough.—September 3rd. Mechanical coal-handling plant for the electricity works. See "Official Notices" to-day.

Pemberton.—August 8th. The Council wants tenders for enclosed arc lamps, street lighting poles. See "Official Notices" to-day.

South Lancashire.—August 7th. The S. L. E. Traction and Power Company wants tenders for the construction of about 30 miles of tramways. Specification (3 guineas), Kincaid, Waller & Manville.

Wigan.—August 10th. The Corporation wants tenders for enclosed motors and starters, 12 months' supply, 1 to 50-H.P. See "Official Notices" July 26th.

Willesden.—The D.C. wants tenders from companies willing to contract for the equipment of their proposed electricity works. See "Official Notices" to-day.

Worcester.—August 23rd. The Corporation wants tenders for water-tube boilers, economiser, pipes and pumps, steam dynamos, motor alternator and booster, Korting condensers, electric pumps, switchboard, crane, and battery for the new electricity works. See "Official Notices" July 26th.

CLOSED.

Barnsley.—It is proposed to accept the tender of Messrs. W. Arnold & Co., of Barnsley, for two boilers for the municipal electricity works at £1,865.

Epsom.—The U.D.C. has accepted the following tenders: 36 additional lamps, Messrs. G. J. Staller & Co., £760; cut outs, the Keighley Electrical Engineering Company, at 10s. 3d. each (subject to the firm providing a deeper sealing chamber); meters, Messrs. Chamberlain & Hookham, 2-wire 3-amp., £2 15s.; 3-wire ditto, £5 10s.; ditto 5-amp., £3 and £6; ditto 10-amp., £3 13s. 6d. and £7 7s.; ditto 25-amp., £3 15s. and £7 10s.

Exeter.—The Corporation have received tenders for the erection and equipment of their new electricity generating station. Tenders for the erection of the buildings, fourteen in number, range from £13,905 to £27,096. In regard to plant, tenders were called for in accordance with a specification prepared by the city electrical engineer, Mr. H. D. Munro, with permission to submit alternative proposals either for the whole or for various sections. For the complete plant there are six tenders as follows:—

S. Z. de Ferranti, Limited, 1,250 KW., to specification for single-phase (present alternators adapted)	£26,461
" " " 1,250 KW., larger units for single-phase (present alternators adapted)	24,657
" " " 1,350 KW., larger units for two-phase (present plant taken over)	26,300
British Westinghouse Company, 1,300 KW. larger units for two-phase (present plant taken over)	28,989
Brush Electrical Company, 1,150 KW., single-phase (present plant left with Council)	28,625
" " " 1,150 KW., two-phase (present plant taken over)	28,715

All the tenders, with the exception of the British Westinghouse Company's, may be reduced by £615 by the acceptance of alternatives. Sectional tenders were sent in by, in addition to the foregoing, Messrs. Babcock & Wilcox, Reinshaw & Co., J. Thompson, Aiton & Co., J. Spencer, Mechan & Sons, Crompton & Co., Hiram Maxim Corporation, Stothert & Co., International Electric Company (Liège), Electric Construction Company, Hick, Hargreaves, & Co., Bergtheil & Young, C. A. Parsons & Co., Rosling, Appleby & Fynn, McLaren, British Schuckert Company, Allgemeine Company, Lahmeyer Company, Siemens Bros., Mather & Platt, Johnson and Phillips, Veritys, Cowans, Heaton & Smith, Barry Henry Company, New Conveyor Company, Blake, Barclay & Co., and Cross & Cross. Three experts, to be named by the President of the Institution of Electrical Engineers, are to be asked upon what terms they will advise the Council in regard to the alternative schemes and tenders.

France.—The French Ministry of Posts and Telegraphs has just placed contracts as follows:—La Compagnie Française des Métaux, Paris, 40 tons of high conductivity copper wire, 2½ mm. diameter, at 220½ fr. per ton, 40 tons of high conductivity copper wire, 2½ mm. diameter, at 221 fr., and 40 tons of high conductivity copper wire, 5 mm. diameter, at 217½ fr.; La Compagnie des Trefileries du Havre, 40 tons of high conductivity copper wire, 2½ mm. diameter, at 220¾ fr., 40 tons of high conductivity copper wire, 4 mm. diameter, at 219 fr., and 40 tons of high conductivity copper wire, 5 mm. diameter, at 217½ fr.; La Société d'Electro-Métallurgie, Paris, 40 tons of high conductivity copper wire, 4 mm. diameter, at 218¾ fr.

Ilkeston.—The T.C. has conditionally accepted the tender of Messrs. Dick, Kerr & Co. for the construction of permanent way and electrical equipment of tramway, including the arc lamps and mains for public and private lighting.

Hammersmith.—Tenders, as under, for the supply of six 50-KW. transformers, came before the Borough Council on Wednesday:—

	£	Drop in volts.	Magnetising watts.	Temperature rise.
British Electric Transformer Company	540	1·8	375	50 F.
International Electric Company	546	2	450	73 F.
British Westinghouse Electric Company	552	1·45	658	40 C.
John Fowler & Co., Leeds	564	1·8	450	60 F.
British Thomson-Houston Company	570	1·75	500	48 C.
Siemens Bros. & Co.	578	1·5	620	70 F.
British Schuckert Electric Company	600	1·8	882	90 F.
John Fowler & Co.	605	1·8	450	60 F.
S. Z. de Ferranti	618	1·8	440	50 F.
Electric Construction Company	630	1·5	460	85 F.
Johnson & Phillips	690	2	425	52 F.
Brush Electrical Engineering Company	822	1·5	450	40 F.

The tender of the British Electric Transformer Company was accepted.

Kimberley.—We learn that the contract for the large independent condensing plant for the De Beers Consolidated Mines, Limited, Kimberley, has been placed with Messrs. T. Ledward and Co., London, for their patent evaporative condenser. We are informed that this well-tried system has more than held its own in all points against foreign competition on many recent occasions, "in spite of the prejudice which exists in many quarters against genuine British manufacture."

Launceston (Tasmania.)—The following is a list of tenders submitted to the Corporation for the supply of electric meters. All prices are calculated for delivery into the Corporation stores duty paid. Five ampere meters, 110 volts, only included in list, except as noted; the first order under contract being for 500 of this capacity. Mr. Wm. Corin, A.M.I.C.E., is the city electrical engineer:—

Name and address of tenderer.	Meter.	£	s.	d.	Remarks.
WATT-HOUR METERS.—INDUCTION TYPE.					
Diamond Meter Co., Peoria, Illinois	Scheefer	2	17	9	Accepted.
Theiler & Co., Zug, Switzerland	Theiler	8	4	3	—
Australian Genl. Electric Co., Melbourne	Thomson	3	8	6	3 & 5 amps.
Noyes Bros., Melbourne	Westinghouse	3	19	6	—
WATT-HOUR METERS.—COMMUTATOR TYPE.					
Australian Genl. Electric Co., Melbourne	Thomson	3	10	10	—
Geipel & Lange, Westminster, S.W.	Vulcan	4	3	2	—
Gibson, Battle & Co., Sydney	Johnson and Phillips.	4	9	8	2½ & 5 amps.
WATT-HOUR METER.—ELECTRICALLY-DRIVEN CLOCKWORK.					
Lawrence & Hanson, Sydney	Avon	4	9	0	—
VOLT-AMPERE-HOUR METERS.—INDUCTION TYPE.					
Chamberlain & Hookham, Birmingham	Chamberlain and Hookham	3	4	3	3 & 5 amps.
" "	Ditto	4	11	6	—
Edison & Swan, Sydney	Round	4	6	1	3 & 5 amps.
" "	Square	5	10	8	—
Allgemeine Elektricitäts Gesellschaft, Berlin.	A.E.G.	3	15	6	3 & 5 amps.
Electrical Company, London, W.C.	A.E.G.	3	12	1	3 & 5 amps.
AMPERE-HOUR METER.					
Noyes Bros., Melbourne	Shallenberger	4	17	0	—
PREPAYMENT METERS.					
Geipel & Lange, Westminster, S.W.	Vulcan	5	2	0	2 amps.
" "	"	5	9	2	3 amps.
Australian Genl. Electric Co., Melbourne	Thomson	7	13	3	3 & 5 amps.

London.—The Fire Brigade Committee of the London County Council received the following tenders for the wiring and fittings required in connection with the electric lighting of the Manchester Square, Bishopsgate and Brompton fire stations:—

	Manchester Sq. £ s. d.	Bishopsgate. £ s. d.	Brompton. £ s. d.
G. Forrest & Son (accepted)	236 10 0	208 10 0	122 10 0
Drake & Gorham	243 15 0	220 15 0	128 0 0
F. A Glover & Co.	245 0 0	220 0 0	143 0 0
The Lighting Corporation	256 9 6	233 10 6	147 6 6
C. Esson	259 0 0	215 0 0	125 10 0
F. J. Coleby & Co.	295 10 0	273 12 0	165 18 0
Laing, Wharton & Cunnington	299 16 0	238 12 0	154 10 0
E. P. Allam & Co.	312 16 0	274 10 0	164 15 0
J. Sperati	378 0 0	313 0 0	186 0 0
Wells & Co.	470 0 0	410 0 0	280 0 0

Manchester.—It is interesting to read that the Manchester Electricity Committee has given a large contract for cranes for the Stuart Street station to Messrs. Higginbottom & Mannock, Limited. The *Manchester Evening Chronicle*, in commenting upon the matter, says:—"Possibly there are some who will be displeased at the placing of the present contract, but the majority will be inclined to the view that it goes a long way towards showing what is becoming more and more generally recognised, that Mr. Higginbottom was very hardly treated last November."

Rochdale.—The Corporation has ordered three electric cars from Messrs. Dick, Kerr & Co., and three from the B.T.H. Company.

NOTES.

Presentation.—The engineering officials of the Dublin District Post Office assembled at the headquarters, Aldboro House, Dublin, last Saturday to do honour to Mr. Charles A. Burge, M.I.E.E., the acting superintending engineer of the Midland district, on the occasion of his promotion. After a long service in Dublin Mr. Burge has

been appointed superintending engineer to the Post Office for the North Wales district with headquarters at Liverpool, and his responsibility includes the whole of the main telegraph and telephone lines and offices in North Wales, and Liverpool, Chester, Shrewsbury, Warrington and other important centres, together with the Isle of Man. The G.P.O. at Liverpool, which is newly built, has an extensive electric lighting and pneumatic plant, and a large trunk telephone exchange system. Mr. Burge's colleagues on the occasion of his departure from amongst them presented him with a 14-day black marble and bronze clock, aneroid and thermometer, and a pair of bronze ornaments to match, together with a solid silver tea set and spoons in a case.

The Possibilities of High-Speed Electric Traction.—The recent passage of the Behr express railway scheme through the preliminary stages in the House of Commons has inspired some eloquent journalists with optimistic, or rather, exaggerated, ideas of what may be done in this direction. The following extract from the leading columns of the *Daily Telegraph* may serve as an example :—

How great will be the revolution, however, should the mono-rail electrical system come into general use, it is easy to see. The problem, for instance, of housing our working population largely depends on the ease with which men can be brought to their sphere of work from considerable distances, instead of the present necessity under which they suffer of living within the distance, at the most, of a mile or two. We have a close congestion round one or two factories and workshops, with all the consequent peril to health, because only by proximity to his sphere of industry can the labourer hope to carry out his daily spell of toil. But if tramways will help to relieve this overcrowding, as Mr. Balfour some time ago suggested, how much more will a mono-rail train, running at the cost of a few pence some 20 miles in 10 or 12 minutes! Everyone who has the welfare of the democracy at heart will wish success to the new electrical traction, if, as its promoters hope, it should open up fresh possibilities of cheap and rapid locomotion.

Without wishing to detract in the least from the merits of the system, we must point out that the above is a wholly mistaken conception of its functions. As a means of rapid transit between important business centres, the high-speed electric railway, in some form or other, has an undoubted future ; but such schemes must be laid out with a view to the payment of dividends. What possible chance would there be for a railway, organised on the lines suggested by the *Telegraph*, to earn a profit ? Such a line would, of necessity, lead from a congested town to an open rural district, and practically the traffic would be confined to the early morning and the evening hours. Moreover, at those times there would be a rush of traffic such as it would be extremely difficult to cope with—impossible, if, as in the Behr scheme, each train consisted of a single car! These conditions are diametrically opposed to those which are most highly conducive to success—a steady stream of traffic throughout the day. Moreover, there is not the slightest necessity to carry the workmen 20 miles away from their work. The real need is an abundance of electric tramways running out into the country, say eight or ten miles, able to pick up and set down passengers at any point on the line of route, and travelling at 6 or 8 miles per hour in the towns, 15 to 20 miles in the country. In this we should but follow the precedent of American practice, which has proved of such immense benefit to the people. No good end is to be served by extravagant statements such as the one which we quote.

The "Cervera" System of Wireless Telegraphy in Spain.—A member of the Technical Committee, engaged in making definite experiments in wireless telegraphy on the system of the Spanish Major Cervera, has just been interviewed. The results have been splendid ; the major has telegraphed with complete success between Tarifa and Ceuta (*i.e.*, across the straits of Gibraltar). He will shortly telegraph from Barcelona to the Balearic Isles. Major Cervera is even certain that he will be able to telegraph from Spain to America ! His system is said to have a great advantage over Marconi's, in that it does not permit of the despatches being intercepted. Near Alicante the Major has fired mines at a distance without wires. He hopes to be able to effect the explosion of the magazines of warships at a distance. The Spanish Government has bought 100 of Cervera's apparatus, and a Belgian company is offering 250,000 francs for permission to work the invention in Belgium.

Electric Motors in Factories and Fire Insurance.—The following is a copy of the revised rules just issued by the combined fire insurance offices, applying to electro-motors in textile mills, wood-working factories, and other premises where the use of open motors is attended with danger. The main point of difference between the new rules and those hitherto in force is that ventilating holes in the outer metal case of motors are allowed, provided they are protected by two thicknesses of wire gauze, set at least ¼-in. apart, and permanently attached to the case :—

Rules for Electro-Motors and Dynamos used in connection therewith (whether exceeding ¼-H.P. or not).

1. Motors, when not in an engine room or in a separate compartment expressly set apart for their use, and built of or lined with incombustible material, must be completely enclosed in an efficient metal case, forming part of the designed construction thereof.

2. Resistances must be similarly situated, or enclosed and constructed entirely of incombustible materials. They must not be fixed within 6 in. of any combustible material.

Note.—Inspection holes fitted with plate glass are allowed. Motors and resistances must be suitably designed to withstand, without serious over-heating, the effect of the absence of ventilation incidental to the use of a metal case. Ventilation, if any, must be only by direct communication with the outer air, or by openings in the vertical portion of the metal case, protected by two thicknesses of wire gauze, set at least ¼-in. apart, permanently attached to the case.

3. The motor pulley (or other mechanical device for transmitting power from the motor) must be external to the metal case enclosing the motor. Only the shaft and the connecting conductors may be carried through into the metal case, or through the wall of the compartment. No belts, ropes or other corresponding gear may be so carried.

Note.—Holes in the case, to admit connecting conductors, must have proper insulating bushings to prevent short-circuiting.

4. Dynamos must be treated as motors.

5. Each motor and each dynamo must have a "switch" and a "cut-out" upon each of its connecting conductors.

6. Switches, cut-outs, and all other regulating and controlling devices must be made of incombustible materials only.

7. Fusible cut-outs not on main or distribution boards must have efficient incombustible covers.

8. All switches when not "on" must automatically turn full "off," and must work from "on" to "off" with a sharp break. The "break" in a switch or other disconnecting device must be of such a length that an arc cannot be sustained.

9. Connecting conductors must have their sectional areas so proportioned that, if of copper, the maximum working current must not exceed the ratio of 1,000 amperes per square inch of such sectional area for currents not exceeding 100 amperes.

10. Motors must not be supplied with current from dynamos or conductors having an earth return.

11. Waste oil from motor bearings and from dynamo bearings must be collected in suitable metal receptacles. Deep metal cans must be provided for oily waste for removal daily.

Lightning.—It having been stated that 11 was the highest total of fatalities from one flash of lightning, Prof. Henry S. Carhart writes to the *Western Electrician* recording a case which occurred during the American Civil War, in which 18 men were killed :—

Major Soule was stationed at one time on Ship Island in the Gulf of Mexico. The tents in which the soldiers were accommodated were conical in shape, with a tent pole in the centre. These tents were intended for 20 men. During a thunderstorm 18 men were in one of them, with their muskets stacked around the central pole. Lightning struck the pole of the tent, divided itself, apparently, among the stacked muskets, and killed the entire company of 18 men. No other casualty from lightning occurred there.

The *Westminster Gazette* last week quoted an old Swiss proverb, which advises :—"If you are caught by a thunderstorm in the woods avoid the oak tree, flee from the fir trees, but seek the beech trees. In order to put the worth of this ancient bit of folk-lore to the test, a statistical examination was made in Canton Lucerne by the forest authorities. Out of 80 trees struck by lightning in a forest district where 17 of the trees were beeches, 56 oaks were struck by the lightning, and 24 firs and larches, but not one single beech. The next inquiry needed is to discover the peculiar quality in the beech to which it owes its comparative immunity."

Readers of the Electrical Review will find a note giving very much the same result in our issue for May 1st, 1896.

The Pacific Cable.—The Pacific Cable Board is prepared to appoint a general manager. Particulars as to qualifications, &c., may be found in our "Official Notices" to-day.

The B.A. Meeting at Glasgow.—The *Glasgow Herald* last week had a general article indicating the arrangements for the September meeting of the B.A., so far as they are yet known. It is stated that for Sec. A (mathematical and physical science), of which Major P. A. MacMahon, F.R.S., is president, a large number of papers are already promised. The following may be mentioned :—Five papers, dealing with elasticity, viscosity, magnetic fields, and stress and magnetisation of nickel and cobalt, are promised from the physical laboratory of the University of Glasgow by Prof. Gray, his assistants, and the research students in his department. Dr. Joseph Larmor, D.Sc., F.R.S., of Cambridge, will give a paper on radiation ; Prof. W. M. Hicks, D.Sc., F.R.S., Principal of University College, Sheffield, a paper on the Michelson-Morley effect ; and Dr. R. T. Glazebrook, of the National Physical Laboratory, a paper on optical glass.

In Sec. B (chemistry), of which Prof. Percy Frankland, F.R.S., of Birmingham, is president, the following papers have already been promised :—"On the Transitional Forms between Crystalloids and Colloids," by Prof. J. H. Gladstone, D.Sc., F.R.S., and Mr. W. Hibbert ; "The Oxidation of Tin, including the Action of Light," by Dr. J. H. Gladstone and Mr. G. Gladstone, F.R.G.S. Papers will also be submitted on electro-chemical processes, and on the manufacture of cyanides.

In Sec. G (engineering), of which Colonel R. E. Crompton is president, a paper on the mechanical exhibits at the Glasgow International Exhibition is being arranged for. After a report on road traction is submitted by a committee appointed for the purpose, papers bearing on this subject will be read by the Lord Justice Clerk (Sir. J. H. A. Macdonald), and Messrs. A. R. Sennett, and A. H. Gibbings. The following papers will also be given to this section :—"Protection of Buildings from Lightning," by Mr. K. Hedges, M.Inst.C.E. ; "Dielectric Hysteresis," by Mr. W. M. Mordey ; and "Aluminium as a Fuel," by Sir W. C. Roberts-Austen, K.C.B., D.C.L., F.R.S., chemist to the Royal Mint.

The National Electrical Contractors' Association.—An enthusiastic and well-attended meeting of electrical contractors was held at the offices of the Sunbeam Lamp Company, Fenchurch Street, on Monday last, for the purpose of forming a London and District Electrical Contractors' Association, with a view to its ultimate affiliation to the National Electrical Contractors' Association. Mr. Rawlings, of Messrs. Rawlings Bros., Limited, presided, and amongst the firms represented were Messrs. Braby & Tomlinson ; Frost, Knight and Co., Limited ; Geipel & Lange ; F. A. Glover & Co. ; Gillard & Co. ; The Lighting Corporation, Limited ; W. R. Woodward ; Emanuel & Son, Limited, &c. After an animated discussion in which several points of great interest were touched upon, notably the gross unfairness of the proposed competition by municipal bodies, a resolution was moved by Mr. W. R. Woodward, forming the association, and this was carried unanimously. A provisional election of officers afterwards took place, and a committee was also appointed to draw up rules, &c. Contractors in London and District desirous of joining this much-needed association are requested to communicate with Mr. Sidney Frost, secretary, 567, Battersea Park Road, S.W.

A French Electrical Convention.—A congress of the Syndicat Professionel des Usines d'Electricité has lately been held in Paris, when a number of papers were read, including one by M. Roux on "Electric Measuring Apparatus," one by M. Brillouin on "Medical Applications of Electricity," and one by M. Deschamps on "Gas Engines Operated by Producer Gas." In the evening a banquet was held, at which M. Mongeot, Under-Secretary of State for Posts and Telegraphs, presided. The day following the members journeyed out to Fontainebleau to witness the inauguration of a service of Lombard-Gerin electric omnibuses, the current to which is fed by means of the overhead trolley system.

The American Association for the Advance of Science.—The annual convention of this association is to be held at Denver, Colorado, from August 24th to 31st.

Personal.—Mr. F. Wiedmann, for many years lamp maker at the Edison & Swan Company's incandescent lamp factory, Kalk-by-Cologne, has, in consequence of these works being closed, left the Edison & Swan Company after nine years' service, and has now undertaken the management of the Elektrische Glühfaden Fabrik, G.m.b.H., Pasing, near Munich, Germany, who make a specialty of the manufacture of filaments for incandescent lamp factories.

The managers of the Edinburgh Royal Infirmary have promoted Dr. Dawson Turner to the office of medical electrician, and Dr. W. Hope Fowler has been elected assistant medical electrician.

We regret to learn that Mr. E. Coote, of the Edison and Swan Company, has been dangerously ill with pneumonia and general collapse owing to overwork. We are glad to learn, however, that he is now making satisfactory progress towards complete recovery.

The staff of the Sir Hiram Maxim Electrical and Engineering Company have presented Mr. E. J. Sanders, late manager of the works, with a tobacco cabinet as a recognition of his kindness and able management. The workers presented him with a salad bowl and servers.

Electromobile Run.—On Monday last, we understand, a remarkable run was accomplished by an electric motor-carriage. Starting from Long Acre, the vehicle—a sporting dog cart, fitted with the "Still" motor and the "Ideal" storage battery—proceeded *en route* to Bath, but owing to the bad state of the roads and the heavy gradients, the journey was terminated at Calne (Wilts) ; the distance covered was over 90 miles on one charge. The total weight of the vehicle was 31¼ cwt. with two passengers, and the battery weighed 17 cwt. Mr. Basil Joy, of the Automobile Club, accompanied the driver to report on the test of the "Still" system.

Appointments Vacant.—Engineering assistants are wanted for the Glasgow Corporation telephone department. The Bedford Corporation wants an electrical engineer at £350 per annum. An electrical and mechanical draughtsman is wanted in connection with the electric lighting at Netley. The Hastings E.L. Committee wants a mains superintendent at £100 per annum.

Libel Action.—In an action for libel before the Lord Chief Justice of England, at Newcastle Assizes, July 11th, 1901, in which the plaintiffs, Messrs. Bennis & Co., Limited, asked for £5,000 compensation, the defendants, Messrs. Ransomes & Rapier, Limited, engineers, of 39, Victoria Street, London, were charged with publishing the results of tests at the Sunderland Corporation's Electric Supply Station, on January 25th and 28th, 1901, between the defendants' "Triumph" stoker and the plaintiffs' compressed-air furnace stoker, in which it was alleged statements were made in respect to excessive clinkering and consequent decreased evaporation of the latter machine, that were not true in substance and fact. It was not denied that plaintiffs abandoned tests on both occasions when only half way through. The jury awarded the sum of £100; this award was, however, according to the *Yorkshire Post* of July 30th, rectified on the previous day at the Leeds Assizes by the Lord Chief Justice, and judgment, with costs, given for the defendants, stay of execution being refused.

The Bristol Tramway Employés.—There is trouble between the Bristol Electric Tramway Company and its men. It appears that 400 of them have been discharged, and that all cars are stopped after sunset "owing to the threatening state of affairs." The company is proceeding against the men for intimidation.

Crowded Out.—Owing to pressure upon our space this week we are compelled to hold over our report of the L.U.T. Bill before Committee, several reports of meetings of electrical and telegraph companies, and a number of letters.

NEW COMPANIES REGISTERED.

Electric Propulsion Company (70,934).—This company was registered on July 23rd, with a capital of £100,000 in £1 shares, to adopt an agreement between Walter L. Allcroft of the one part, and Edward J. Outram, on behalf of the company, on the other part, for the purchase of certain letters patent relating to an electric motor and an electric battery, and to carry on the business of manufacturers of, dealers in and agents for the sale of electric vehicles of all descriptions made in accordance with the letters patent the subject of the aforesaid agreement or of any other letters patent or otherwise howsoever, and all articles and things used in the manufacture, maintenance or working thereof, cycle, bicycle, tricycle, velocipede and carriage builders and merchants, engineers, machinists, millwrights, saddlers, galvanisers, japanners, annealers, enamellers, electro-platers, &c. The first subscribers are:—W. L. Allcroft, 2, Ryder Street, S.W., civil engineer, with 100 shares; W. M. Barber, 20, Woodland Road, New Southgate, Middlesex, manufacturer, with 100 shares; G. Rowell, 6, Cavendish Place, Cavendish Square, London, F.R.C.S., with 1 share; G. H. Willis, 59, Chancery Lane, W.C., solicitor, with one share; E. J. Outram, 59, Chancery Lane, W.C, secretary, with one share; C. B. J. Smith, 8, Nutford Place, London, clerk, with 1 share; and A. D. Taylor, 79, The Grove, Wandsworth, S.W., clerk, with 1 share. Minimum cash subscription, £12,000. The number of directors is not to be less than two nor more than seven; the first are Walter L. Allcroft, Walter M. Barber and George Rowell; qualification, 100 shares; remuneration as fixed by the company; registered office, 79, Chancery Lane, W.C.

Morgan, Mondey & Co., Limited (70,973).—This company was registered on July 26th, with a capital of £3,000 in £1 shares, to acquire the business of Morgan, Mondey & Co., and such part of the business of Messrs. H. & W. Green as may consist of dealing in electrical appliances, and generally to carry on the business of electricians, electrical, mechanical, sanitary, gas and water engineers, ironmongers, builders of electric tramcars, motor cars, carriages, cycles, vehicles, dynamos, motors, telephonic bells, electroliers, arc and other lamps, electric light fittings, heating and cooking apparatus, metals, india-rubber, asbestos and insulating material, contractors for the supply of electricity, manufacturers of chemical and medical apparatus, &c. The first subscribers (each with one share) are:—T. C. Morgan, 13, College Street, Rotherham, electrical engineer; F. W. Clayton, 66, Chippenham Street, Sheffield, manager; H. W. Green, 37, Warwick Street, Rotherham, photographic dealer; W. W. Green, 145, Kimberworth Road, Rotherham, photographic dealer; J. Phillips, 13, College Street, Rotherham, electrical engineer; T. C. Lewis, Warren Lane, Chapeltown, Sheffield, iron turner; G. Bentley, 385, Sheffield Road, Templeborough, Rotherham, engineman. No initial public issue. Registered without articles of association. Registered office, 13, College Street, Rotherham, Yorkshire.

Electric Haulage Company, Limited (70,927).—This company was registered on July 22nd, with a capital of £10,000 in £1 shares, to adopt an agreement with G. Davis and E. W. Rudd, for the option to purchase certain patents in respect of an invention of an improved system of distribution and collection of current for electric traction, and other rights and privileges, to acquire any other inventions and to carry on the business of electrical engineers, manufacturers of electric motors and electrical apparatus and appliances, makers of electric tramway cars and other vehicles, rail, conductor and trolley manufacturers, &c. The first subscribers (each with one share) are:—E. Hughes, 50, Mark Lane, E.C., managing director of Tilbury Lighterage Company; G. Davis, 34, Victoria Street, S.W., electrical engineer; A. Bathurst, 52, Lincoln's Inn Fields, W.C., solicitor; G. H. Gordon, 148, Alexandra Road, N.W., secretary; A. J. Borer, 50, Mark Lane, E.C., clerk; A. G. Hughes, 28, Wickham Road, Brockley, S.E., engineer; and J. G. W. Aldridge, 9, Victoria Street, S.W., consulting engineer. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are G. Davis, and others to be appointed by the subscribers; remuneration as fixed by the company.

CITY NOTES.

The Edison & Swan United Electric Light Company.

The report and accounts of the Edison-Swan Company, to be presented at the eighteenth annual meeting to be held to-day, disclose a grave condition of affairs. "The fall in the market quotation of the shares, the changes which were known to have been made in the staff, and other reasons, led to the formation of a committee," which has made an examination into the affairs of the company, and nominates two new directors. It is to be presumed that this committee is also responsible in part for the measure of candour and recognition of facts which the report discloses. The profit and loss account shows that £19,514 has been carried to net revenue account, of which £18,242 has been absorbed by debenture interest. It was found that in previous years work which had been completed at a loss was reported as "work in hand," and carried forward as an asset. This discovery led to further inquiries into the value of the stock, with the result that £31,048 had to be written off therefrom. The Broadheath, Walsall, and Kalk factories were found to be unremunerative, and closed. The cost of closing these factories, amounting to nearly £10,000, other outlays of nearly £20,000 and the depreciation of the stock, amounting together to roughly £60,000, have, with the interim dividend and provision for doubtful debts, absorbed the whole of the reserve.

Whilst the condition of affairs as disclosed by the report is sufficiently alarming, the business men amongst the shareholders may question whether the measure of candour and recognition of facts to which we have alluded goes far enough. It is one of the drawbacks of limited liability investment that shareholders seldom desire, or seldom have the opportunity of arriving at unpleasant facts in one stage. The balance sheet—omitting items of share capital appearing on both sides—may be summarised as follows:—

The debentures (£444,023), creditors and accrued interest amount to £459,878 2s. 5d., and the freehold and leasehold property (£89,200), stock, and plant (£293,535), debtors, sundry payments in advance, investments at cost, and cash, amount to £489,613 11s. 3d.

The liability on share capital is £383,478, and the only other assets are "cost of establishing the business," goodwill, and remaining patents (£325,631), and Altrincham Electric Supply, Limited, debentures, shares, and goods supplied, total £390,526 11s. 2d.

No independent valuation is given for the freehold and leasehold property. The stock is considerable, but the value given it may be accurate for a going business. The new directors will doubtless consider how much is for current stock and how much represents articles subject to changes in fashion, such as fittings, or advances in the industry, such as appliances. The investment taken at cost would not have realised that amount at June 30th, but we see no reason for assuming that the depreciated value at that date necessarily represents its ultimate realisable value. It may reasonably be asked why the Edison & Swan Co., which pays 5 per cent. on some of its debentures, should invest in a 5 per cent. preference share of the National Telephone Company? We do not doubt that the directors were at the time sufficiently advised in so investing. For the Altrincham Electric Supply, Limited, in which approximately £65,000 is invested, we presume the Manchester Company is originally responsible. As interest on the debentures has been accruing since 1897, it is clear that the investment either requires considerable nursing, or that the security is of so intangible a nature as to be classed with goodwill, as in our summary of the balance sheet. In expressing their sincere regrets at the unexpected results now shown, the directors "desire to say that they are of opinion that the business if properly conducted is good," and that with certain changes "the company can once again be placed in a satisfactory commercial position." It would be a great misfortune if one of our oldest electrical manufacturing companies—embodying in its title the names of pioneers in the invention of electric incandescent lighting—were to remain in the condition its present report discloses. Holding for years a monopoly of the manufacture of incandescent lamps, it embarked later into the business of electric supplies. Which department of its business is responsible for the shrinkage in profits and assets? The profit and loss account does not show this; but it does show that the company sold £285,667 worth of goods, and the expense of conducting the business was £63,811. It is not unlikely that the shareholders may be told, as they have been told before, that some reticence is necessary in imparting information which may be utilised to the detriment of the company's business, as well as for the enlightenment of the company's shareholders. The contention should not be entirely disregarded; but the shareholders should be satisfied, through a committee or otherwise, as to which are the paying departments of the company's business. It is to be regretted that in replacing the retiring directors there is not nominated someone who is identified with the electrical industry and familiar with the commercial side of it. We are bound to recognise that Mr. Forbes's health and domestic bereavements are ample justification for reducing his engagements; but we cannot but regret that the necessity arises at this juncture in the affairs of a company of which he has been chairman since the commencement. The shareholders will do well to remember that in their name and connection, and the high character of their manufactures, they should have a valuable asset; but that the value of a business is represented rather by the returns than by what it cost to establish. This as an item of asset will clearly have to be modified. The business will have to be brought up to the standard of the capital, or the capital reduced to the standard of the business. The debenture interest is a serious burden, but there seems plenty of room for economies in the "salaries and expenses of sales departments." The shareholders have certainly reason to complain that the company has been allowed to drift into its present position. They have received their

6 per cent. too long. The first care must now be to provide debenture interest. The present report prepares them in part to realise the situation, but it is clear from the accounts and the auditor's observations that there is yet another stage to a complete recognition of the facts. The encouraging feature is that there is business to be done, and that it ought to be done at very much less cost. The important consideration is the appointment of directors and management who can reduce the cost of doing the work whilst maintaining the connection. There is a chance for the company in the words of the report, "if properly conducted," words which the directors apply to the future, but which it is impossible to read without applying them to the past.

Sir Hiram Maxim Electrical and Engineering Company.

An extraordinary general meeting was held last Friday at the offices, 65 and 66, Gracechurch Street, E.C, under the presidency of Mr. Jules de Meray, at which resolutions for the alteration of the articles of association were passed, to comply with the Stock Exchange requirements. This was the first time they had met since the acquisition of the late Maxim Corporation.

The Chairman said that the business of the company could be divided into three important departments—the lamp factory, the engineering contract department, and the export department. With regard to the lamp factory, since they had acquired it, a great many changes and improvements had been made. The late manager of the Hiram S. Maxim Corporation had entered into a contract with the company to purchase the whole of the output of their factory at a price which the directors considered favourable. The contract provided that orders for not less than 1,000,000 lamps per annum would be given to the company, but a very much larger trade was anticipated. A deposit of £5,000 was paid to them as security for the fulfilment of the contract. To carry out this arrangement a separate company had been formed, with a capital of £60,000 issued, £15,000 of which was cash working capital, and £20,000 was to be handed over to their company in shares, as a condition of their entering into the contract. The engineering department was under the management of Mr. Howard T. Wright, who was the manager of Messrs. Edwards & Barnes, engineers, whose business this company bought some time ago. Some weeks ago they secured an important contract from the Cardiff Corporation, which was now in hand. They had taken up the making of electric cable troughs, for which they had secured an order, now being completed, amounting to about £10,000. They had also been offered the construction of a light railway, and subject to the financial arrangements being satisfactory, he thought that they might say that this order was practically secured. They had been asked to tender for what would be one of the most important electric and steam mining railways in Spain—a matter with which they had associated themselves with the firm of Messrs. G. J. White & Co., of London and New York, and in conjunction with that firm they had submitted a scheme which they believed would be accepted. They had had in hand for the past 12 months, work of the value of £40,000, and they had had submitted proposals amounting to over £300,000, which were in fact under consideration. Their total capital was only £175,000, and their £40,000 of working capital was almost untouched.

City and South London Railway Company.

At the half-yearly meeting held at the offices last Friday, Mr. C. G. Mott, who presided, ran briefly over the past history of the company, showing that the policy of gradual extension which the board had pursued from the commencement had fitted in with the events of the period, and had led to the present improvement in the affairs of the company now that it is on the eve of its most important development, namely, the completion of the extension from Moorgate Street to Islington. The directors' report has already appeared in our columns, and in moving its adoption, Mr. Mott said that in June, 1899, by very careful economies in every direction, they were able to declare a 2¼ per cent. dividend for the half-year, but that was without allowing anything for depreciation or renewals. There was no chance of that dividend being long maintained except from tapping new sources of traffic. To-day they had tapped those sources partially, and they now saw the result. This half-year, notwithstanding the fact that they had had all the additional capital to pay upon, and all the additional interest charges, they had earned enough to have paid that 2¼ per cent. They had now arrived at the time when they were absolutely earning practically the same dividend as they earned with the restricted line which had no possibility of advancing in the future, but rather had the probability of decreasing dividend. In addition they now had a line rapidly increasing in traffic, and developing every week, and with great possibilities in the future. The plan which they had had in mind for so long had been really justified by the results, and he hoped that the Islington opening would bring a very large increase of traffic. They had various sources of traffic to come on in the future from connections with other lines, and so on. The reason they were not able to pay the 2¼ per cent. dividend this half-year was that having made no reserve for renewals they had been met at the end of the first 10 or 11 years—the machinery had been working for 12 years—with the necessity of substituting a new and completely-improved plant for the old one. They might have gone on with the old plant, and had nothing to say about the question of renewal, but that would not have been in the interests of the shareholders. They put in entirely new plant and sold off the old plant for what they could get, the loss involved being £8,000 after deducting the amount received for the sale. That £8,000 they had to write off the capital account, and of that they had cleared out £3,000, leaving £5,000 for the future. It was a heavy pull upon the half-year, and they had practically taken ½ per cent. from the dividend for the time being. They thought it better to clear it off in the next half-year or two as quickly as possible, and then to adopt a moderate renewal fund, so that they would not have claims of this kind suddenly coming upon them. If they had set aside £350 per half-year since the opening of the line they would have had the whole amount required in hand. After referring briefly to the company's Bill before Parliament, the chairman said that the St. Mary Woolnoth Church arbitration award had been given, but it was in such a condition that they did not know the exact position of it. It would be a long time before the matter was finally settled. The additional capital they had got by their present Bill was necessary to pay off certain loans and so relieve the charges of the company, and to enable them to buy certain additional rolling stock. Only a portion of the new stock would be issued at present. The chairman then turned to explain in his usual detailed manner the accounts and the increases and decreases of the half-year. The train-miles run showed an increase of 144,857. The number of trains run was 93,592, as against 80,437 in the previous half-year, an increase of 13,155. The number of passengers per train had grown from 57 to 62; the receipts per train had grown from 8s. 8 6d. to 10s. 10d. The train-mile receipts were very nearly the same; there was a slight decrease because of the large additional mileage run. Receipts per passenger averaged as nearly as possible 2d. The most remarkable and satisfactory part was the reduction in the working expenses. The corresponding half-year last year they were 59·36 per cent., and they were now reduced to 52·36 per cent. They began originally with working expenses 79 per cent., and they had gradually got this down to 52·36. If they had had no lifts to work the expenses would have been only 41¼ per cent. The expenses per train-mile were reduced during the half-year from 1s. 4·7d. to 1s. 3·19d. The locomotive charges, notwithstanding the high price of coal and materials, had been reduced from 5·97d. to 4·93d. That was a most satisfactory reduction, and a very small charge for locomotive and generating power. It spoke well for the management of the engineer in his department. These figures proved, when one compared them with the large steam railways, what a large advantage the electric railway had over such lines. Instead of locomotive charges being 4·93d. they would probably find them 1s. or more on many of the lines, and the percentage of working expenses would come out at close upon 70 per cent. for this half-year, instead of 52·6d. The company had now turned the corner; their difficulties were practically at an end, and they had every prospect of large traffics, and of moving steadily onward with their dividend. He then moved the adoption of the report, which motion Mr. Grenfell seconded.

After a number of shareholders had offered sundry congratulatory and suggestive remarks, and these had been suitably replied to by Mr. Mott, the report was adopted, and a motion declaring dividend passed.

An extraordinary general meeting followed, at which resolutions were passed relating to the issuing of debenture stock.

The Edison & Swan United Electric Light Company.

The report for the business year ending June 30th, 1901, to be submitted to the meeting to be held at Cannon Street Hotel to-day at one o'clock, reads as follows:—

"The directors submit herewith the report and accounts for the year ending June 30th, 1901. The profit and loss account shows that the sum of £19,514 4s. 1d. has been carried to net revenue account, £18,242 15s. of which has been absorbed in payment of interest on the debenture stock. Competition in every branch of the business has been very keen, lamps especially being sold at very diminished prices. The price of materials has considerably increased, hence the cost of production has been higher, and as the sales have been smaller, the business has suffered seriously. At the last meeting of the shareholders the chairman announced that a new manager of the fittings department had been appointed. On his getting to work, everything in that department was thoroughly overhauled and examined. During this investigation it was discovered that, in the past, work which had been completed at a loss was reported as 'work in hand,' and carried forward as a good asset. This led to further changes; amongst others, the general manager was removed from that office, and the directors set on foot a special inquiry into the value of the whole of the stock belonging to the company; and they regret to say that they have found it necessary to write off therefrom the large sum of £31,048 5s. When this company absorbed the Manchester Edison-Swan Company it took over the Broadheath factory, and as it was found impossible to work it at a profit it has been closed; such plant as could be beneficially utilised has been removed to Ponder's End and the rest has been sold. The Walsall and Kalk factories have also been closed, and the loss on the closing of these factories has been provided for in the accounts. The sums of £31,048 5s. depreciation of stock, £19,875 14s. 4d. special outlays written off, £9,069 7s. 9d. loss on closing factories, and £4,578 provision for bad and doubtful debts, together with the interim dividend paid March 1st of 2½ per cent., amounting to £9,586 19s., have absorbed the whole of the reserve; £784 is carried

forward as against £6,199 18s. 5d. last year. The fall in the market quotation of the shares, the changes which were known to have been made in the staff, and other reasons, led to the formation of a committee, which consisted of shareholders holding more than one-fourth part of the "A" shares of the company. A deputation from this committee has had several interviews with the directors, has visited Ponder's End, and has made an examination into the affairs of the company. As the result of these meetings an arrangement has been arrived at between the directors and the committee, by which two seats at the board have been placed at the disposal of the committee, and in accordance with this Mr. E. B. Ellice-Clark and Mr. H. Wolfenden have been nominated for election as directors at the ensuing meeting of shareholders. Mr. J. S. Forbes, who has been chairman of the company from its commencement, resigned his seat on the board on 19th of the present month, stating that he was compelled to reduce his engagements owing to domestic bereavement and from considerations of health. Major Flood Page retires in rotation, and offers himself for re-election. Mr. E. Villiers retires in rotation, and does not offer himself for re-election. Mr. E. B. Ellice-Clark and Mr. H. Wolfenden have been duly nominated to serve as directors, and offer themselves for election accordingly. The directors have in this report placed before the shareholders fully and unreservedly the result of the special examination which has occupied them for several months. In expressing their sincere regret at these unexpected results, they desire to say that they are of opinion that the business, if properly conducted, is good, and that there is reason for believing that with certain changes in organisation and in policy, which have been already under consideration, and which will have to be decided when the board is reconstituted, the company can once again be placed in a satisfactory commercial position. Messrs. Welton, Jones & Co., the auditors, offer themselves for re-election. A form of proxy is enclosed for the signature of the shareholders; if it is wished to make it available for use at the meeting it must be in the hands of the secretary not later than Wednesday, July 31st, at 1 p.m."

Prospectuses.

In our advertisement pages to-day will be found a copy of the prospectus of the Electric Propulsion, Limited, whose nominal capital is £100,000 in £1 shares, of which 75,000 constitute the present issue; 20,000 are taken by the vendor as part payment of the purchase money, and 55,000 are offered for subscription until Tuesday next, 6th inst., on which day the list closes. The performances of the Still motor carriages of the Canadian Electric Vehicle Company in last November's trial runs have been referred to in our columns, and the report of the judges, extracted in the prospectus, speaks of their "excellent record." There seems to be a doubt as to whether the battery of No. 12 car weighs 6½ or 7 cwt, both figures being quoted in the prospectus. The purchase consideration, which is divisible between W. L. Allcroft and W. M. Barber, is £59,000 in fully paid shares or a balance in cash at £80 per £100. The Still system is claimed to be "the first to be brought before the public for the manufacture of electric vehicles upon a practicable and commercial basis." It is stated that there are reasonable anticipations that the works will be kept fully occupied for a long time to come. A factory is to be equipped in or near London, but a Toronto company will supply the equipments necessary to start on a fair scale pending completion of the works.

A prospectus is now being placed before investors which invites subscriptions for 10,000 5½ per cent. £10 preference shares, 15,000 £10 ordinary, and £150,000 of 5 per cent. debentures, in the Blackpool Electric Tramways (South), Limited. The company will deal with the whole of the existing Blackpool tramways on the south side of the town, known as the Blackpool, St. Anne's and Lytham Tramways, extending from South Shore Station in the borough, through St. Anne's-on-the-Sea, Ansdell, Fairhaven, and Lytham, to a point beyond the Lytham terminus on the road to Preston. The tramways are at present the property of, and are worked by, the Blackpool, St. Anne's and Lytham Tramways Company, Limited. The contractors, it is stated, have obtained an option to purchase the effective majority of the shares of the company. An Act of Parliament has been obtained for the conversion of the lines for electric traction, the laying down of double lines, and the increase of speed. The advisory engineers are Messrs. Bramwell & Harris, and Mr. S. B. Cottrell of the Liverpool Overhead Railway. The directors are mostly men connected with electric tramway systems. The list is headed by Sir R. Mottram, the chairman of Galloways, Limited.

Waterloo and City Railway Company.

The report of the directors for the half-year ended June 30th last, to be submitted to the meeting on August 8th, states that the capital account shows a total outlay of £599,184 on June 30th last. The further estimated expenditure of £15,000 is provided for by the capital powers of the company. The gross receipts of the line, less Government duty, amounted to £16,315, and the working expenses to £8,937, being at the rate of 54·78 of the receipts. The difference between these two amounts is not sufficient, by the sum of £1,567, to pay a dividend at the rate of 3 per cent. per annum on the company's ordinary and borrowed capital, and the working company has, therefore, under the agreement of March, 1894, made up the deficiency, and have deducted in respect of working expenses, the sum of £7,370. The number of passengers carried during the past six months, exclusive of season ticket holders, was 2,134,062, showing an increase of 265,325 over the number carried in the corresponding period of 1900. The season ticket holders on June 30th last numbered 1,057, as against 911 at the end of June, 1900.

Dublin United Tramways Company.

The half-yearly report of this company has been issued for the six months ending June 30th, 1901. A dividend at the rate of 6 per cent. per annum is declared on the preference shares and at 4 per cent. on the ordinary shares. These dividends absorb £29,028, leaving a balance of £3,372 to be carried forward. The results of the half-year's working have been adversely affected by the exceptional charges which the company had to meet under the head of compensations for accidents and legal expenses connected therewith amounting to the sum of £6,337. An insurance policy has been taken out for one year from March 1st last, covering all claims for accidents up to £7,500 in the aggregate, or £1,500 in the case of any one accident, except for claims arising from horses slipping on the pavement, the company's liability for which is now the subject of an appeal to the higher Courts; £3,050 is the amount of the premium for the year. Contracts for a year's supply of coals have been made at 9s. 9d. per ton, as against an average cost of 15s. 10d. per ton during the past half-year.

Globe Telegraph and Trust Company, Limited.

The 28th half-yearly meeting was held at Winchester House on Tuesday, the Marquis of Tweeddale presiding. In moving the adoption of the report, the Chairman said that the receipts, less expenses, amounted to £197,136, a decrease of £1,284. That was not a decrease in revenue, but was almost entirely due to the fact that they had to pay interest on the large number of shares in the Eastern Extension Company, which were allotted to them in consideration of their holding in that company. The allotment was something like 11,000 shares. Their receipts from the companies in which their money was invested, amounted to £204,541, or an increase of £1,680. This enabled them to recommend a dividend at the rate of 6 per cent. on the preferred shares, and 4s. 6d., or at the rate of 5¼ per cent. on the deferred shares. This was the third consecutive year they had paid that handsome dividend. The chairman then proceeded to refer in detail to the company's holdings in Anglo-American Telegraph, Direct United States Cable Company, Eastern Extension, Submarine Cables Trust, and the Telegraph Construction and Maintenance Company, and discussed the outlook of these companies so far as dividend earning prospects are concerned. He concluded by saying that everything pointed to at least as prosperous a period for the Globe Trust this next half-year. The company was never in a better position.

The report was adopted, motions declaring dividends passed, and the retiring director and auditors re-elected.

Anglo-American Telegraph Company.

The directors' report, to be presented to the half-yearly meeting to-day at Winchester House, at 2 o'clock p.m., reads as follows:—

The total receipts from January 1st to June 30th, 1901, including the balance of £1,156 1s. 5d. brought forward from the last account, amounted to £188,357 16s. 11d. The traffic receipts show a decrease of £3,954 as compared with the half-year ended June 30th, 1900. The total expenses of the half-year, including the repair of cables, &c., amounted to £64,979 8s., being an increase of £4,195 1s. 8d. as compared with the corresponding period of 1900. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £111,378 13s. 11d. One quarterly interim dividend of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, was paid on May 1st, 1901, absorbing £52,500, and a second quarterly dividend of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500 will be paid on August 1st, 1901. The balance of £6,378 13s. 11d. will be carried forward to the next account. All the main cables and landlines of the company are in good working order.

National Telephone Company.—The directors have resolved to recommend the following dividends for the half-year ended June 30th last, after charging £17,673 against revenue, being the special expenditure incurred in repairing damage caused by the snowstorms in the early part of the year:—At the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares. At the rate of 5 per cent. per annum, less income-tax, on the third preference shares. At the rate of 5 per cent. per annum, less income-tax, on the ordinary shares, carrying £65,000 to reserve, and about £6,000 forward. The transfer books of the company will be closed from the 2nd to the 15th August, both days inclusive, and the dividend warrants will be posted on the latter date.

Electrical Power Storage Company, Limited.—An extraordinary general meeting of this company was held on the 30th ult., when the resolution confirming the alterations in the articles of association, agreed to at the annual meeting, was passed.

Westminster Electric Supply Corporation.—The directors have declared an interim dividend for the half-year ended June 30th last at the rate of 10 per cent. per annum.

Stock Exchange Notices. — The Committee has appointed a special settling day as under:—Thursday, August 8th, Thames Ironworks Shipbuilding and Engineering Company, Limited, £100,000 5 per cent. registered second mortgage debentures of £100 each, Nos. 1 to 1,000. The Committee has also ordered the undermentioned to be quoted in the Official List:—

Bournemouth and Poole Electricity Supply Company, Limited, further issue of 1,500 ordinary shares of £10 each, fully paid, Nos. 6,001 to 7,500; and 1,500 cumulative 4½ per cent. preference shares of £10 each, fully paid, Nos. 13,501 to 15,000; Thames Ironworks Shipbuilding and Engineering Company, Limited, £100,000 5 per cent. registered second mortgage debentures of £100 each, Nos. 1 to 1,000.

The Brush Electrical Engineering Company, Limited.—The directors have declared an interim dividend at the rate of 6 per cent. per annum on the preference shares for the half-year ended June 30th, 1901, payable on September 1st, 1901. The transfer books will be closed from August 18th to September 1st, both inclusive.

Oldham, Ashton and Hyde Electric Tramway, Limited.—The transfer books will be closed from August 1st to August 15th for preparation of warrants for interim dividend on the ordinary shares at the rate of 5 per cent. per annum for the half-year to June 30th, and on the preference shares at the rate of 5 per cent. per annum for the half-year to August 15th.

County of London and Brush Provincial Electric Lighting Company.—The directors have declared an interim dividend on the preference shares at the rate of 6 per cent. per annum, less tax, for the half-year ended June 30th, and an interim dividend on the ordinary shares for the same period at the rate of 4 per cent. per annum, less tax, both payable on August 22nd.

Metropolitan Electric Supply Company. — The directors have declared an interim dividend of 6s. per share on the original shares and 4s. 6d. per share on the new shares, being at the rate of 6 per cent. per annum.

Kensington and Knightsbridge Electric Lighting Company.—An interim dividend at the rate of 10 per cent. per annum for the half-year ending June 30th, 1901, has been declared on the ordinary shares, payable on and after August 8th.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramways.—The receipts for the week ending July 27th were £1,038; corresponding week last year, £1,351: decrease, £513. Total to date, £4,231; corresponding period last year, £4,592; decrease, £361.

Bristol Tramways and Carriage Company.—The receipts for the week ending July 26th were £4,675; corresponding period last year, £3,545; increase, £1,130.

Central London Railway.—The receipts for the week ending July 27th were £5,956; previous week, £6,218; increase, £264. Total receipts to date (four weeks), £24,898. Miles open, 6.

City and South London Railway.—The receipts for the week ending July 28th were £1,906; corresponding week last year, £1,611; increase, £296. Total to date, £7,550; corresponding period last year, £5,904; increase, £1,646. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending July 27th were £269 8s. 11½d.; corresponding week last year, £270 10s. 8½d.; decrease, £1 1s. 9d. Total to date, £5,232 5s. 2d.; corresponding period last year, £5,563 8s. 8d.; increase, £368 16s. 6d. Miles of track open, 3. Car miles run, 1901, 5,123; 1900, 5,032. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending July 26th were as follows:—D.U.T. Co., electric cars, £3,953 19s. 1d.; D.S.D. Co., electric cars, £1,108 18s. 9d.; total, £5,062 17s. 4d.; corresponding period last year—D.U.T. Co., electric cars, £4,601 7s. 8d.; ditto, horse cars, £34 2s. 5d.; D.S.D. Co., electric cars, £1,252 11s. 6d.; total, £5,288 1s. 7d.; decrease, £225 4s. 3d.; aggregate to date, £19,478 2s. 6d.; aggregate to date last year, £18,914 4s. 2d.; increase, £563 18s. 4d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year.

Liverpool Corporation Trams.—The receipts from the cars for the fortnight which ended on July 20th, amounted to £20,318 13s. 10d., as compared with £11,091 13s. in corresponding fortnight in 1900. The total receipts from electric and horse cars were £20,501 8s. 7d., compared with £17,493 10s. 9d. in the fortnight last year. The number of passengers carried during the fortnight of the present year was 4,383 377 by electric cars, and 36,784 by horse vehicles. Compared with the corresponding period of last year, this was an increase of 1,033,901. There were 328 electric cars and seven horse vehicles at work, as compared with 140 electric cars and 152 horse cars, 292 in all at the same period last year.

Liverpool Overhead Railway.—The receipts for the week ending July 28th were £1,608; corresponding week last year, £1,671; decrease, £63. Total from July 1st to date, £6,906; corresponding period last year, £6,864; increase £42. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The electrical markets cannot at all events be accused of featurelessness this week. Dull and uninteresting as are most departments in the Stock Exchange at the present time, there is notable movement afoot in several directions amongst those securities which we talk about in this column. The marked recovery in Central Londons is hardly as sensational as the knock-down blow administered to Edison & Swan shares, but it is of more public interest. There are several interesting dividends in the supply section, and a lot of business has sprung up in National Telephone Ordinary shares. Telegraph stock continues apathetic, and there has been fresh selling of British Electric Traction shares on the new issue, referred to by us last week. Amongst the latest comers, Power-Gas shares have been afforded considerable support, but the same observation does not apply to Electric Propulsions.

The remarkable jump in Central London Ordinary and Deferred stocks is due to good buying, added to a fair amount of repurchases amongst the bear brigade. It is urged that if the Central London can do so well in a half-year which has proved so disastrous to most of the other lines, it should be able to give an even better account of itself under less costly conditions of fuel and labour. Certainly, there seems to be no lessening of the line's popularity, and the only effect of the vibration scare seems to have been the securing to the company as good an advertisement as if it had been boycotted by a foolish State official. We quite expect to see a steady advance in the Preferred stock, which is certainly a good 4 per cent. investment at par.

City and South London descriptions do not change, allowing for deduction of the dividends, nor is Waterloo and City altered, the regular 3 per cent. notwithstanding, which, by the way, was not all earned. Metropolitan and Metropolitan District are 78 and 29, respectively; both companies are still at variance as regards the system of electrification that shall be adopted. It is interesting to notice that Messrs. Ganz & Co., whose system is favoured by the Metropolitan Railway, are preparing plans for electrifying some of the main lines of railway in Hungary.

British Electric Traction Ordinary, as noticed above, have relapsed a further fraction owing to sales by those who want to take up the new shares offered at 13 by Messrs. J. S. Morgan & Co. They too are quoted *xd*.

Dividend announcements in the Electric Supply division have had little influence upon quotations. The County of London and Brush announcement—4 per cent. as an interim dividend—passed almost unnoticed, and the Kensington's rate of 10 per cent. per annum failed to replace the 10s. which the quotation lost a week ago. The Metropolitan is paying at the rate of 6 per cent. per annum, the same as last year, and the shares are shorn of ½, as are also Notting Hills.

Disastrous is almost too mild a word to apply to the Edison and Swan report. That work should have been completed at a loss, and then reported "work in hand," and as such carried forward as a good asset would appear incredible, did not the company's report state in black and white that this is what happened prior to the recent overhauling of the fittings department. The directors removed the then general manager, started a special inquiry into the value of the stock, and found it necessary to write off no less than £31,048 5s. Every penny of the reserve fund has been wiped out, and the munificent sum of £784 is carried forward. To crown everything Mr. J. S. Forbes, after being chairman of the company from its birth, resigned his seat on the board a fortnight ago. What wonder, then, that the "A" shares are all but unsaleable at a few shillings, and that the other securities are flat as ditchwater!

In the telegraph department, Anglo "A" has slid back ½, although the report is considered in the Stock Exchange to be a good one, competition considered. Eastern 3½ per cent. Preference is harder, and a point rise is registered in "China" Debentures. Indo-Europeans came on offer and fell £2. National Telephones are a lively market on the appearance of the report. Buyers and sellers seem pretty fairly divided, and the quotation is virtually unchanged. Chili Telephones are stationary; the report is eminently satisfactory, and the shares should be held for an improved quotation. Several of the securities in this department are now *ex* dividend, but the changes amount to very little.

Miscellaneous varieties are hard, with the exception of Edison and Swan, already noted. Henley's Debenture stock is a point up. Business in Sir Hiram Maxim Electrical and Engineering shares is being done on the basis of 1⅛ to 1¼, transactions consequent upon the company's meeting and Sir Hiram's optimistic and interesting speech thereat. The Dublin United Tramways Company has declared a 4 per cent. dividend on its Ordinary shares. The price of these shares is £12 middle, and the Preference are 15, while the 3½ per cent. Debentures are par. Calcutta Tramways Debenture is strong at 105, and the London United Company's 4 per cent. Debenture is 106. Buenos Ayres and Belgrano Ordinary are 1¼, the same price as Cape Electric Tramways. Blackpool is somewhat excited over a scheme put forward by the Blackpool Electric Tramways (South), Limited, which is to deal with all the existing tramways on the south side of the borough. Advance prospectuses have been freely circulated in the Stock Exchange this week, and the issue is regarded as one of considerable interest. The Electric Propulsion, that new company, has failed to make many friends in Capel Court, and the vendors are asking a lot of money for a very little of tangible security. But, of course, there are points in the prospectus which may tempt the speculatively inclined.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for he last three years. 1898.	1899.	1900.	Closing Quotation July 24th.	Closing Quotations July 31st.	Business done during week ended July 31st, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —101 xd	98 —101 xd	...	...
119,700*l*	Amazon Telegraph 5 % Debs., Nos. 1 to 4,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700*l*	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	53 — 56	52 — 55 xd	...	...
3,088,540*l*	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	99 —101	97 — 99 xd	99⅞	99½
3,088,540*l*	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	9⅜— 10¼	9¼ — 10	9⅞	9⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3¾— 4¼	3¾— 4¼	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185 xd	...	...
1,589,496*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102¾	101½
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000*l*	Do. do. 4½ % Debs.	50	...	...	...	99 —103% xd	99 —103% xd	...	...
60,710*l*	Direct United States Cable	20	3½%	3½%	3½%	10½— 11½	10½— 11½	...	...
104,300*l*	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	143 —148	140 —145	147½	141¾
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	91 — 94	92 — 95	94	93
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	110 —114	110 —114	114	113½
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13¾— 14¼	13¾— 14¼	14 3/16	13⅞
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	110 —115	110 —115	...	...
300,000*l*	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼ %	...	100 —103	101 —104	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5¼%	10 — 10⅛ xd	10 — 10⅛ xd	10 9/16	10⅛
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾— 15¼	14¾— 15¼ xd	15⅛	15
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	30 — 32	...	...
78,000*l*	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 -102 xd	99 —102 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	43 — 47	41 — 45	...	...
100,000*l*	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 — 106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	½— 1	½— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3¼— 3½	3¼ — 3½	3½	3 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅛— 4⅜	4⅛— 4⅜	4¼	4⅛
2,000,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	90 — 93	89 — 92	90¼	89
500,000*l*	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98 xd	94 — 97	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1	⅞— 1	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102 xd	99 —102 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5¼xd	5 — 5¼	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼ xd	4⅜— 5¼xd	...	...
179,947*l*	Do. do. 5 % Debs.	Stock	...	...	...	101 —104 xd	101 —104	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	102½	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000*l*	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜—14¼ xd	13⅜— 14¼	13⅞	...
75,000*l*	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104 xd	101 —104 xd	...	...
348,777*l*	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103 xd	100 —103 xd	102½	101¼
88,321	West India and Panama Telegraph	10	2 %	2½%	...	⅜— ½	⅜— ½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	4½— 5½	4¾	4⅝
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½— 9	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	5½	5⅜
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5½— 6	5½— 6	...	...
150,000*l*	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110 xd	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12 — 13 xd	...	...
400,000*l*	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	120 —125 xd	120 —125 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9½	8½— 9½	9	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000*l*	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	103 —106 xd	103 —106 xd	...	...
35,300	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½— 6	5½— 6 xd	5 13/16	5 11/16
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6 xd	...	...
120,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	102 — 105xd	102 —105 xd	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12 xd	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 —105	101 —104 xd	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000*l*	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13⅜— 14½	13 — 14	13 11/16	...
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	...	...	...	108 —111 xd	108 —111 xd	...	...
250,000*l*	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	94 — 97 xd	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	14½— 15½	15 — 16 xd	14 13/16	14⅝
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½xd	14 9/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½xd	8½	...
150,000*l*	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100 xd	97 —100 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2	2 — 2½	...	...
50,000*l*	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	11½— 12	11½— 12½	...	...

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. † Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

section, and a lot of business has sprung up in National Telephone

may tempt the speculatively inclined.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation July 24th.	Closing Quotation July 31st.	Business done week ended July 31st, 1901. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14 —14¼xd	13¾ — 14¼	14⅛	14
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 12½	12 — 12½	12⅛	12 5/16
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	124½	124¼
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11 xd	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6 — 6¼xd	6 — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1¾ — 1¾	1⅝ — 1⅞	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2⅛ — 2⅜	2⅜	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102 xd	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 —15	14 — 15	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	107 —111 xd	107 —111	...	...
206,297	Central London Railway, Ord. Stock	Stock	...	...	...	90 — 93	98 —101	102	93
78,703	Do. do. Pref. half-shares	5	...	...	...	99 —102	99 —102	102	101¼
78,703	Do. do. Def. do.	5	...	...	...	92 — 95	97 —100	98½	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1½%	53 — 55	52 — 54 xd	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5½— 5⅝	5½— 5⅝	..	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	8 %	3½— 4	3½— 4	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105 xd	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	1 — 1½	0 — ½	7/16	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	2 — 3	1½ — 2½	1½	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85 xd	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	92 — 96	88 — 92	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅝— 2¼xd	1⅝— 2¼xd	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½— 3 xd	2½— 3 xd	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102 xd	98 —102 xd	..	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16½	15½ — 16½	16⅜	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½— 6	5½— 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	108 —112	109 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅜%	3½%	8 — 8⅛	7 1/16 — 7 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13¼	13 — 13¼	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	37 — 41 xd	37 — 41	39	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	... %	...	101 —104 xd	101 —104 xd	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½— 11½	10½— 11½	10¾	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 6	5 5/16	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 93	90 — 93	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—3/16
National Electric Free Wiring, 12/6 paid, 1/8—1/4.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16¼.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, July 31st.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	23/-	23/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) .. per ton	£33 10	£33 10	..
a ,, ,, .. per ton	£30	£30	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£15	£15	..
a Bensole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90%) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£23	£23	..
a Lead, Nitrate .. .. .. per ton	£24	£24	..
a ,, White Sugar .. .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a ,, Caustic (75/80%) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	61/-	61/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a ,, Crystals .. .. .. per ton	£8	£8	..
Bichromate, casks .. per lb.	2¾d.	2¾d.	..

METALS, &c.	This week.	Last week.	Inc. or Dec.
b Aluminium Wire, in ton lots.. per ton	£224	£224	..
b ,, Sheet, in ton lots per ton	£191	£191	..
p Babbitt's metal ingots.. .. per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis per lb.	7¾d.	7¾d.	..
c Tube (brazed) .. .. per lb.	1ud.	1ud.	..
c ,, ,, (solid drawn) .. per lb.	8¼d.	8¼d.	..
c ,, Wire, basis .. .. per lb.	8d.	8d.	..
c Copper Tubes (brazed) .. per lb.	11d.	11d.	..
.. ,, ,, (solid drawn) .. per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) .. per ton	£85	£85	..

METALS, &c. *(continued.)*	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£85	£85	..
g ,, Rod .. .. .. per ton	£85	£85	..
e ,, (Electrolytic) Bars .. per ton	£82	£82	..
e ,, ,, Sheets .. per ton	£90	£90	..
e ,, ,, Rod .. per ton	£84	£84	..
e ,, ,, H.C. Wire per lb.	9¾d.	9¾d.	..
f Ebonite Rod .. .. per lb.	8/-	8/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. per lb.	1/5	1/5	..
h Gutta-percha fine .. .. per lb.	8/-	8/-	..
h India-rubber, Para fine .. .. per lb.	3/6 to 3/7	3/6½ to 3/8	dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) .. per ton	45/4	45/-	4d. inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. .. per ton	59/- to 62/6	70/- to 72/6	20s. dec.
i ,, Wire, galvanised No. 8 .. per ton	£10	£10	..
g Lead, English Ingot .. .. per ton	£12 2 6 to £12 5	£12 7 6 to £12 10	5s. dec.
g ,, ,, Sheet .. .. per ton	£13 10	£13 10	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bot.	£9	£9 2 6	2s. 6d. dec.
d Mica (in original cases), small .. per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large .. per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. per oz.	£4 1	£4 1	..
p Silicium Bronze Wire .. .. per lb.	10¾d. to 1/0½	10¾d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n per ton	From £15	to £40	..
i ,, ,, in bars	£58	£58	..
g Tin, block .. .. per ton	£120 to £121	£125 to £126	£5 dec.
g ,, foil .. .. per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16 .. .. per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand .. .. per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea. .. .. per lb.	6d.	6d.	..
j ,, Hemp, 8 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. .. per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sh't. (Vielle Montagne pnd.) per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

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Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Quotations on Liverpool Stock Exchange.

IMPORTANT EUROPEAN ELECTRICAL AND ENGINEERING DEVELOPMENTS.*

By WILLIAM J. HAMMER.

(*Continued from page* 80.)

The Steam Turbine.

The very important work done in recent years upon the development of that oldest of steam engines, the steam turbine, bids fair to revolutionise steam engine practice, and although it is self-evident that it does not possess the universal applicability of the ordinary steam engine, there is a very large field open for its application, and it is particularly well adapted to the needs of electrical engineers.

It is remarkably simple and compact, requires a minimum of attention and repairs, has no valves and no rubbing surfaces, except in the bearings, which in the forms employed show an insignificant wear, and the internal parts require no lubricant, consequently there is no danger of carrying grease into the boilers where they are fed by water condensation from surface condensers, and the absence of packing glands and internal rubbing surfaces permits of the use of steam of high degrees of superheat.

As there are no reciprocating parts and everything is so perfectly balanced, the foundations are of but slight expense, it being only necessary to support so much dead weight. The turbine itself is comparatively light and economical in first cost and in operation, and will regulate within a very small percentage from no load to full load. In the ordinary steam engine live steam is admitted into the cylinder, which had been cooled but a moment before by its connection with the exhaust, the resulting condensation is not apparent in the steam turbine to any extent, owing to the gradual temperature changes and constant temperatures maintained at any given point.

The De Laval turbine has been extensively employed in Europe, and to some extent in this country. A 300-H.P. unit, connected to two dynamos of corresponding output, is the largest turbine of this type which has thus far been built. As indicative of the high class of workmanship and care necessary in constructing this type of high-speed steam engine, I would call attention to the large gear wheels, which I was informed at the Humboldt Works at Kalk, Germany, each took 14 days to complete. I made particular inquiries of various turbine manufacturers regarding the amount of wear of the blades, and was invariably told it was inappreciable where superheated steam was used. The de Laval Company exhibited a 300-H.P. turbine wheel at the recent Paris Exposition, in which the blades showed no apparent wear after having been in use for seven years. Prof. R. H. Thurston's recent test upon a de Laval turbine showed an increase in economy of 1 per cent. for each 3° F. of superheat, and that with 37° of superheat the capacity of the turbine was doubled, due almost entirely, he claims, to the lessening of the skin friction.

The turbine wheel is mounted upon a very slender shaft, whose flexibility permits of its great deflection, due to the forces set up by the turbine wheel running at such high speeds, and permits the wheel to revolve about its axis of gravity.

Two steam turbines were ordered by the City of Elberfeld, Germany, from the firm of C. A. Parsons, direct connected to 1,000-KW. three-phase generators. A recent test was made by Messrs. Weber, Lindlay and Schroeter, to determine steam consumption under different loads with the following results:—Average pressure 11 atmospheres, the steam was superheated 14·3° C.; dynamo load 1,190 KW. (overload), 955 KW. (full load), 745 KW. (¾ load), 499 KW. (½ load), 247 KW. (¼ load); the number of pounds of steam consumed per KW.-hour was respectively 19·3, 20·1, 22·2, 25·4, and 33·8. When running without the field magnets excited, the engine consumed 2,604 lbs. of steam per hour; when running with no load, but field magnets excited, the turbine consumed 4,057 lbs. of steam per hour. The variation in speed from no load to full load, and *vice versâ*, was 3·6 per cent.; with non-inductive load the fall in voltage from no load to full load was 1·02 per cent., and with inductive load under similar conditions 11 per cent. This is the largest steam turbine constructed abroad up to the present, 1,500 H.P., but is exceeded by the Parsons 3,000-H.P. turbine installed by the Westinghouse Company recently in Hartford, Conn.

The Sulphur Dioxide Gas, or "SO_2" Engine.

In 1899 Mr. R. Behrend, an engineer of Hamburg, Germany, and Dr. Zimmerman, of Ludwigshafen, patented a system which they had invented for utilising the heat units contained in exhaust steam, and their tests showed gains as high as 56 per cent. additional power secured, without the expenditure of 1 lb. additional fuel. The system developed by them, and used upon an experimental engine plant, was not brought to perfection, by reason, among other things, of the difficulty in securing proper acid pumps. The improvements in ice-making machinery have now supplied the requisite pump, and a large amount of valuable data and experience. The results which they secured were so promising, that they brought them to the attention of Prof. E. Josse, of the Kgl. Technische Hochschule, of Charlottenburg, Germany, an authority on subjects of this character, and they requested him to examine into the practicabilty of their ideas, and eventually to make further tests. Prof. Josse, following up the work of Messrs. Behrend and Zimmerman, secured results of the greatest interest and importance, and the work which he now has in hand, at Charlottenburg, is being carried forward in the interests of the three largest electrical concerns in Berlin, *i.e.*, Siemens & Halske, the Union Elektricitäts Gesellschaft, and the Allgemeine Elektricitäts Gesellschaft.

The system which has been developed is quite simple, and is briefly as follows:—

As is well known in steam engine practice, after steam has done its work in the cylinder or cylinders of a steam engine, there results a very considerable loss of heat energy when the steam is discharged into the open air, or passed through the condenser. When exhausted in the open air, it has a temperature of about 212° F., and in passing into a condenser it has a temperature of about 140° to 160° F., depending upon the amount of vacuum. The latent heat of steam given up in the changing from steam to hot water has heretofore been wasted in the condensing water or in the air. Messrs. Behrend & Zimmerman, desiring to utilise this waste caloric, employ it to create a new supply of power by vaporising a liquid having a boiling point considerably lower than that of water, and after extensive experiments, adopted sulphurous acid ($H_2 SO_3$), a substance which is readily and economically obtained. Ammonia, nitrogen and benzol might also be thus employed, but the sulphurous acid possesses the advantage that it can work in a cylinder without lubrication, which is not the case with ammonia. The pressures corresponding to the available temperatures are also favourable to the employment of this liquid. The working apparatus first tested at the Technische Hochschule consists of the steam

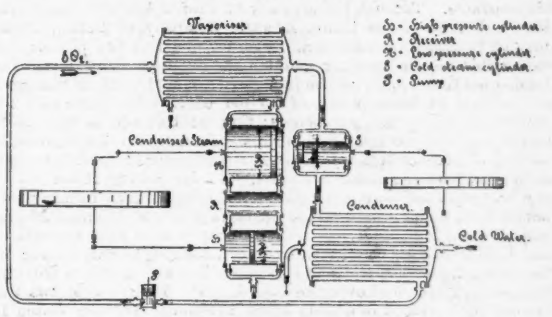

Fig. 6.—Diagram Showing the Relations of Working Parts of SO_2 Engine.

engine, which has a pump for its load; the vaporiser; the SO_2 engine; and the SO_2 condenser. This arrangement was designed by Prof. Josse. The principle and mechanical details are illustrated diagrammatically in fig. 6. The dimensions given are in millimetres. The letters H and N represent the high and low pressures of an ordinary compound steam engine, with a stroke of 19·69 in., and a speed of 41·5 revolutions per minute. From the low pressure cylinder end, exhaust steam passes into the surface condenser, or, as it is termed, the "vaporiser." In this vaporiser or condenser the sulphurous acid ($H_2 SO_3$) is utilised as the cooling medium instead of water. The heat of the exhaust steam liberates sulphur dioxide (SO_2), which, passing into a cylinder of the auxiliary engine, s, does work as if it were an ordinary steam engine. This auxiliary cylinder has a diameter of 11·81 in., a stroke of 19·69 in., and a speed of 77 revolutions per minute. After being utilised in this cylinder, the sulphurous vapour passes through the tubes in the surface condenser (shown in the diagram), around which tubes cold water is flowing, which condenses the sulphurous vapour again into sulphurous acid, which is pumped by the pump, P, back into the vaporiser, where it begins its cycle again—the same acid being used over and over again without loss. The machine is thus, in fact, a closed heat engine. In a long series of tests made with the engine, the following results were attained. The engine, which is of the compound type, of modern construction, developed with a steady load 34 I.H.P., with a consumption of 18·96 lbs. of steam per I.H.P.-hour. The auxiliary engine working with the sulphurous vapour indicated 19 H.P. That is an increase of 56 per cent., yielding, instead of 1 H.P., 1·56 H.P. for the same steam consumption, and reducing the steam consumption from 18·96 to 12·13 lbs. per I.H.P. The experiments show on the average that for every 15 kilogrammes or 33·169 lbs. of steam passing through the main engine, 1 H.P. could be gained in the auxiliary cylinder. Applied to an ordinary single cylinder steam engine, exhausting directly into the air at a high temperature, the percentage of power saved by this new system would be much higher than the economy reached in these experiments, which are made with an improved compound engine. It is claimed that, given a fairly economical compound engine using 16·5 lbs. of steam per I.H.P.-hour, half an I.H.P. could be produced in the auxiliary machine for each I.H.P. developed in the main engine, assuming an average vacuum of 23·62 in., corresponding to a temperature of 140° F. The saving of heat must be accomplished by using a liquid which can be vaporised at or below that temperature, and produce a high pressure. Assuming the upper and lower limits of temperature, within which the operation is confined, to be 140° and 67° F., the pressure of the sulphurous vapour would range from 10·05 to 2·35 atmospheres above open air pressure. A working pressure as high as ordinary steam boiler pressure is therefore readily obtained, at a compara-

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

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tively moderate temperature. The volume of sulphurous acid vapour necessary to contain the number of heat units, corresponding to the work to be performed, is much smaller than the volume of steam which would be required for the same purpose. As the saving to be effected depends directly upon the difference between the highest and lowest temperatures involved, the greater gain will therefore be made, either when the water in the surface condenser is as cold as possible, or when the heat of the exhaust steam from the engine is at a maximum, as is the case with a single-cylinder steam engine without condenser, which may be anywhere up to 212° F.

Sulphur dioxide gas or vapour is of a somewhat viscous character, and lubricates the working surfaces of the machinery, without producing corrosion. There is thus a considerable saving of lubricants. The expense of this improvement is practically covered in the cost of the auxiliary engine or extra cylinder attached to an ordinary engine, and the vaporiser, condenser, piping, and pumps. It is claimed that a 2,000-H.P. central station engine would furnish power to drive an additional 1,000-H.P. SO_2 engine, which can be connected as an extra cylinder to the steam engine, or run independently, and thus increase about 50 per cent. the power developed, without adding a pound to the quantity of fuel consumed. Prof. Josse states that in mining and iron works districts there are a large number of engines, condensing and non-condensing, which consume more than 10 kg. of steam per H.P-hour, and in such cases 2,000 H.P. would be gained in a plant of 3,000 H.P. by the use of the cold vapour engine.

A triple-expansion steam engine, to which an SO_2 gas engine has been attached, is being used for supplying light and power to the technical high school in Charlottenburg. Exhaustive tests have been made, and are being made, on this engine by Prof. Josse and his assistants. Through the courtesy of Prof. Josse and Mr. Louis Magee, director of the Union Electric Company, of Berlin, I was enabled to secure the data here presented, and had the pleasure of seeing this engine running and undergoing test. Prof. Josse informed me that even with the triple expansion the SO_2 engine gave an increase of horse-power of 35 per cent., with practically no increase in the operating expenses; that he believed it was inadvisable to go higher than double expansion, and that the preferable method of construction was to place the cylinder of the SO_2 engine in tandem with the steam cylinders. On my asking if there was any danger in moisture getting into the system, thus forming sulphuric acid, which would attack the surface of the cylinder, &c., he said this was impossible. It is of interest to note that the Allgemeine Elektricitäts Gesellschaft is now installing an SO_2 engine in its Markgrafenstrasse station in Berlin. The system is not without its disadvantages, and even possible danger. Everyone knows the discomfort produced in a room where a common sulphur match is ignited, and in all types of engines there is always a possibility of a leak occurring. A comparatively small amount of sulphur dioxide gas produces a large amount of discomfort, and a large amount of it may incapacitate those working about the machinery, and if exposed thereto for a considerable length of time, may even result in death. There are also the well-known corrosive effects produced. These are not cited with a view of disparaging this most interesting development, but would rather serve to indicate that for such a system to be most successful, the SO_2 engine should be operated as an independent engine, and so boxed in and ventilated as to reduce to a minimum the disadvantages resulting from possible leakage. The care of this engine is exceedingly simple, as no lubricant is necessary, and as for the existing steam engine, absolutely nothing need be changed. In the methods of construction very great care is taken to reduce the chances of leakage to a minimum. Great care is taken in the packing of the stuffing boxes, and in addition an extra stuffing box is placed on the cylinder, and connected to the condenser, so that although the pressure inside of the cylinder is 14 atmospheres, there is a pressure of but from 1 to 1½ atmospheres at the outer stuffing box. Prof. Josse says the engine can be made absolutely scentless, and that no difficulty need be experienced on this score. He also says the results of his tests far exceeded the original calculated and estimated results, and completely justify the practical application of the Behrend system for the improvement of steam engines.

A Trolley Omnibus.

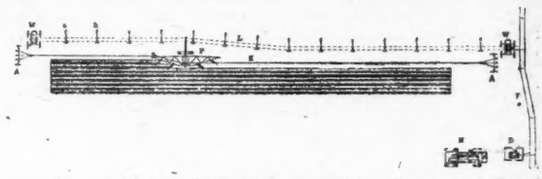
An electrical omnibus in the Vincennes Annex of the Paris Exhibition was flexibly connected with a travelling trolley, which was driven by an electric motor and which travelled along on two overhead wires. The current supplied to the motor on the omnibus was a direct current, and connections were made therewith, so as to supply three-phase current to the motor driving the trolley-carrier. On starting the omnibus the current was first thrown on to this overhead motor, so that it started along on the trolley wires and remained continuously in advance of the omnibus as it passed along the road. The trolley wires were suspended first on one side of the road, then on the other, and at times in the centre, and the omnibus itself wended its way in and out of the numerous vehicles on the road with perfect facility. It would seem that there are various places where such a trolley automobile could be applied, but it does not seem essential that the overhead motor should be driven by a three-phase current while the line and omnibus motor itself are supplied with a direct current.

The Electric Plough.

During my stay in Berlin I was shown an improved form of electric plough at work in the suburbs of Berlin. Direct current at 500 volts was supplied from the neighbouring station of the Berlin electricity works, and the plough itself was equipped with three ploughshares at each end, and was estimated to do the work of 15 horses. The illustration serves to indicate how in this system the line wire was connected to the travelling reels and to the trolley lines, and shows how this line is moved sideways across the field as the plough progresses. I found it necessary to walk quite rapidly to keep up with the plough, which was simultaneously cutting three deep furrows in soft loam in a very impressive manner.

Ganz & Co.'s High Tension Three-Phase Railroad System.

Through the courtesy of Director Otto F. Blathy, of Messrs. Ganz and Co., of Buda-Pesth, I was enabled to examine into the company's high tension three-phase railroad system, which is now being installed upon the Lecco, Sondrio and Chiavenna line in North Italy, and which system was, at the time of my visit, being run experimentally upon a circular track a mile in length at Alte-Ofen Island, in the Danube, near Buda-Pesth, Hungary. The length of the Italian electric road, which up to the present has been operated



A, anchors; P, plough; K, feeding chain; M, engine; D, dynamo; F, trolley wires; L, line wires; S, line carriers; W, reels.

Fig. 7.—Diagram of Electric Ploughing System.

by steam, is 66 miles, and the maximum grade 22 per cent. It is safe to say that this road, by reason of its great length, problems in freight and passenger haulage, high potential employed, and its special electrical and mechanical features, represents the most interesting electrical railway installation now under construction, and it will be followed with the greatest interest. The motive power now being arranged for represents about 7,400 H.P., with facilities for increasing when necessary. The power will be derived from a waterfall near Morbegno, 9½ miles from Calico and 15½ miles from Sondrio. Four 2,000-H.P. Schuckert three-phase dynamos generating 20,000 volts at 15 cycles are direct-connected to four turbines, which are supplied from a raceway between two and three miles long, delivering 35 cubic metres of water per second and having a fall of 30 metres. The three-phase current of 20,000 volts will be supplied direct to the line, and the 12 sub-stations will transform it to 3,000 volts and supply 12 independent sections of the railway line, each of which is equipped with fuses. Two overhead trolley wires 8 mm. in diameter represent two of the phases and the track the third. The line insulators are of porcelain, having five petticoats decreasing in size from top to bottom. The line wire, which is of copper, is 7 mm. in diameter. The sections of road are operated upon an ingenious block system; when the stop-signal is set the line circuit is opened, and simultaneously the powerful brakes on the train are set. Passenger and freight traffic are operated independently. The freight locomotives will be of 700 H.P., employing four motors, and capable of hauling 250 tons at a speed of 19 miles an hour up a 10 per cent. grade. The passenger locomotives are also equipped with four motors, each weighing about 3½ tons and representing 300 H.P. The scheduled speed is about 27½ miles an hour on the level and about half that on grades. The 3,000-volt current is taken from the trolley lines by two copper rollers 16 in. long and having a diameter of 3½ in. These rollers, which are mounted in the same axial line, revolve upon steel ball bearings (through which no current, however, passes) and are separated by 5 in. of hard wood saturated in paraffin under pressure. On the left and right side of this pair of rollers are copper cones about 8 in. long, rigidly connected to the trolley support. The base of the trolley is mounted on a long horizontal hinge on the top of the car and connected to a piston of an air cylinder, so that the trolley can be raised and lowered by air pressure. Each of the "primary" or high-tension motors has its trolley with double rollers. Collecting brushes running on graphite collars take the current from the two rollers, being held against them by spiral springs. The current is then led by highly insulated wires, protected by grounded metallic tubing, to the motors. Each car is mounted on two four-wheel trucks, and is equipped with two "primary" and two "secondary" induction motors, or four in all, each of 150 H.P. Each rotor weighs about 1½ tons. The air-gap is between 4 and 5 mm. The 3,000-volt current passes directly to the stationary windings of the "primary" motors. In starting the train or in climbing a grade the motors are connected in "cascade"—that is, the windings of the "primary" rotors, which are designed for 300 volts, are connected to the stationary windings of the "secondary" motors, while their rotors are connected to the fluid resistances; this gives a speed of about 18½ miles per hour. When speed is attained the controller-handle (which has only two positions, "half-speed" and "full-speed") is thrown to its second point, which throws the stationary fields of the "primary" motors on the line, and their rotors on the fluid resistances which are slowly cut out of circuit, the secondary motors meantime being thrown out of circuit. This arrangement gives a speed of 37½ miles per hour. The wires in both field and rotor windings are invisible, as they pass longitudinally through insulated tubes in the iron, and at the ends of the windings are insulated by mica and protected by plates or caps bolted on. The controllers at each end of the car are connected mechanically, and the high-tension switches are connected electrically. A small transformer on the locomotive connected to the line delivers current at 100 volts to a three-phase motor for compressing air for use on the air-brakes, operating the high tension switch, raising and lowering the

* Abstract of paper read by [illegible] before the American Institute of Electrical Engineers, February 28th, 1901.

fluid in the resistance boxes (which is simpler than raising the plates), and for raising and lowering the trolley. The same transformer supplies current for lighting the train; Cruto three-phase incandescent lamps are employed. The periodicity being but 15 per second, the fluctuations were too noticeable in the ordinary lamps, so the Cruto 3-filament lamp was employed and showed no fluctation.

(To be continued.)

TEST OF A 1,000-H.P. GAS ENGINE AND COMPRESSOR PLANT AT HALSEY STATION, PENNSYLVANIA.

Details of a test of the above plant are published in the *Sibley Journal of Mechanical Engineering*. Natural gas is used, the thermal value of which is about 1,175 B.Th.U. This is a high value, but is due to the large percentage of ethane in the gas. Three runs were made at different loads of four hours each, with the following results:—

Run.	1.	2.	3.
Intake pressure, pounds ...	1	2	Atmos.
Discharge „ „ ...	262·4	275·7	266·3
Standard gas per hour in cu. ft.	5,620	6,053	5,425
Ratio air to gas	15·7	15·28	16·67
Jacket water per hour in lbs.	22,970	37,610	36,670
„ „ range temp. comp. F.	9	5	5
„ „ „ „ engine F.	89	69	60
Temp. of exhaust (water off)...	702	725	640
„ „ („ on)...	465	507	410
Indicated M.E.P.			
Cylinder 1	80·7	87·2	80·2
„ 2	97·02	104·3	94·04
„ 3	91·5	92·2	87·8
„ 4	97·7	102·8	98·9
Indicated H.P.			
Cylinder 1	164·4	177·8	163·8
„ 2	197·7	211·9	192·0
„ 3	186·2	202·0	179·3
„ 4	199·2	209·4	201·6
Total	747·5	801·1	736·7
Developed H.P. (comp.)			
Cylinder 1	155·2	176·9	157·1
„ 2	156·1	171·9	149·5
„ 3	152·8	166·3	146·7
„ 4	139·8	150·5	141·2
Total	603·9	665·6	594·5
Friction H.P.	143·6	135·5	142·2
Mechanical efficiency per cent.	80·8	83·08	80·7
Thermal „ „	28·8	28·65	29·4
Absolute „ „	23·3	23·8	23·7
Cu. ft. gas per I.H.P. per hour	7·52	7·55	7·37
„ „ „ D.H.P. „	9·31	9·06	9·13
Lbs. jacket water per I.H.P.-hour	30·73	46·95	49·77
„ „ „ „ D.H.P. „	38·03	56·50	61·68
Cu. ft. gas pumped per hour ...	169,650	184,558	158,271
Cu. ft. gas pumped per hour per cu. ft. used	30·2	30·5	29·8

Heat Balance.

Run.	1. B.T.U.	Per cent.	2. B.T.U.	Per cent.	3. B.T.U.	Per cent.
Supplied per hour	6,607,000	100	7,115,000	100	6,377,000	100
Absorbed per hour by jacket water	2,051,000	31·0	2,606,000	36·6	2,237,000	35·1
Exhausted ...	835,000	12·6	916,000	12·9	762,000	11·9
Therm. equiv. of I.H.P. hours ...	1,902,000	28·8	2,039,000	28·7	1,875,000	29·4
Radiation and loss	1,819,000	27·6	1,554,000	21·8	1,503,000	23·6

BONDS, BONDING AND BOND TESTING METHODS *

By ALBERT B. HERRICK.

The question of the best bond to use and the proper section of bond to be used for a given current density in the rails is one that has been given much consideration by street railway managers. There are so many types of bonds, all of which have their individual merit, that it is hard to distinguish which would be the best under given conditions of rail, fish plate and paving.

It is required of any bond that it make good electrical connection between the bond wire and the rail itself; and this connection should present ample surface, not exceeding 90 amperes per sq. in., for the mean current flowing through the bond. The terminal of the bond should be of such a metal as not to naturally corrode by contact with the iron rail.

The wires or rod forming the bond should possess either welded or cast contacts with the terminals connected to the rails. A new bond presenting large surfaces of contact will show very low resistance, but my remarks refer principally to those bonds which are between two and five years old and which were connected on rails in service subject to vibration and corrosion. It is found in measuring a great many of these bonds that, whereas a large area gives a low resistance under laboratory conditions, the surfaces in contact are not under sufficient pressure to prevent moisture from creeping in and gradually corroding them.

It is found that better results are obtained by reducing the surface and increasing the pressure. In this connection it may be mentioned that the channel pin bond has shown with a time test a very small contact resistance. The channel pin referred to is the half-round pin, which forces the bond wire itself against the internal surface of the hole drilled in the rail. The type of channel pin which surrounds the bond wire and acts as a wedge between the bond wire and the hole in the rail, presents two surfaces of contact to the current flowing through the bond and consequently doubles the hazard of a poor connection.

To amalgamate the surface of a bond of copper (brass cannot be amalgamated because it disintegrates when amalgamated) will improve any bond, and besides increasing the area of contact under lower pressure the amalgam will fill any crevice, through which the moisture works by capillary action between the contact surfaces. Very often copper in railroad work is misplaced in the bonds, due to the use of a common-sized bond throughout the whole length of road, whereas in localities adjacent to the power station the current density is greatly in excess of that received at the outlying points on the road. The rule to be followed should be that there should be in a bond a cross section of at least 100,000 c.m. per 100 amperes returned on the rail. Of course this is the sum of the two bonds on each rail or the four bonds in the case of double track. The application of this rule gives the tapering bond system, which would cost the same in copper as the continuous bond system of uniform size; but the conductivity in the graded case would be much greater than in the case of uniform bonding.

Often the trackman puts the bonds in, and in his judgment a mechanical connection must be an electrical connection. It has been my experience that a great many bonds have been condemned because of improper work in placing them. The bond can be made just as tight in a rusty hole as in a clean one—but in the one case it is worthless and in the other it forms good contact. A bond for which the hole has been drilled with oil shows slightly higher resistance when new, but with age the difference between the hole drilled with oil and the hole drilled without it does not appear.

In bonding rails it is most evident that there should be no moisture present. The rail should be dry as well as the bond, and bonding should never be attempted during rainy or foggy weather. This depreciates the contact surfaces so quickly that it can be easily detected in testing over the track. In those sections which have been bonded during rainy or damp weather the action of the moisture seems to start corrosion between the iron and copper.

Bonds can be put down on a merit system with the best results, for then the men will find out for themselves the best method of bonding to ensure electrical connection. The following method has been used with success: to pay 18 cents for the application of a bond, whose resistance is ·002 ohm or less and 9 cents for a bond whose resistance does not exceed ·0025 ohm; all bonds having a resistance of over ·003 ohm to be replaced without cost. This, of course, is for a certain bond with an area of contact of 1·37 sq. in. and $\frac{7}{8}$ in. diameter of wire, the web of the rail being $\frac{1}{2}$ in. thick, and the hole in the rail $\frac{5}{8}$ in. The copper was expanded into the hole by a plug.

In new tracks bonding can be tested as soon as the current is turned on the trolley wire, by methods explained later on. In roads where the rail is exposed, bonds placed under the fish-plate are being extensively used on account of the exposed bond wires being stolen. In this case the bonds should have sufficient flexibility to allow the rails to contract and expand without fracturing the connections between the flexible and riveted portions of the bonds.

It will be noted that expansion and contraction does not fall equally on all rail joints, but that an occasional joint catches most of the movement of the rails due to temperature changes. Consequently to test this type of under-fish-plate bond the movement should be greater than the contraction and expansion of individual rail lengths. In order to test whether this type of bond has the proper flexibility, two levers can be fixed so that the movement of the bond can be made greater than the normal movement of the rail, and this change in position of the rivet heads can be made four or five hundred times, in order to ascertain whether the connection between the head and the flexible portion of the bond will stand this movement without a fracture.

An expanded bond will allow some little variation between the hole and the shank of the bond, which fits the hole, but in the riveted bond there should be a close driving fit. Where the rails have been ordered drilled before being laid, it is well to have them drilled $\frac{1}{64}$ in. smaller than the shank of the bond, so that reaming the hole will remove the rust and still the bond will be tight fitting. Where there is a face contact to consider, the reamer should have a rose on it which will ream the face of the rail as well as the hole. Generally with expanded bonds, also having face contact, the expanding of the bond forces the face out of contact, and the true contact is on the internal surface of the hole.

It has been and is still sometimes the practice to use a supple-

* *Street Railway Review.*

horses. The illustration serves to indicate how in this system the brakes, operating the high tension switch, raising and lowering the

mentary wire connected to the bonds and zigzagging from the bonds on one track to those on the other.

For the same cost per mile, using the same amount of copper in the bond, or using the same amount of wire for the bond that would be used for supplementary wire, a great deal better result will be obtained; for a section of a 50-lb. rail is equivalent to 20 No. 0000 B.W.G. wires or approximately 4,000,000 c.m., whereas a No. 0 wire, which is generally used, has $\frac{1}{20}$th the conductivity of the rail. The greatest economy in ground return losses is largely in favour of increasing the bond at the joint instead of using the supplementary wire. There are certain treacherous parts of the road which should not be depended upon to continue the conductivity of the track, especially at railroad crossings. Here the bonds should be supplemented by using an auxiliary bond wire having a section of 150,000 c.m. per 100 amperes; this should be connected back to at least eight bonds each side of the crossing, so as to give no greater current density than 60 amperes per inch of contact to both tracks adjacent to the crossover.

On railroad bridges, both wood and iron, it is very difficult to maintain bonding, and here supplementary wires should be provided in the same way as on railroad crossings. Draw bridges, of course, should be bonded with copper sufficient for the maximum current flow on the rails adjacent to each side of the draw. The inside

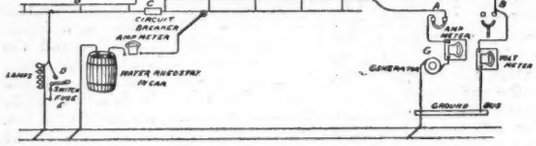


Fig. 1.

rail on curves shows a decided tendency to break the bond connections. I have not been able to satisfy myself as to why this is so, but I have found it so in many cases. At the tangents to each end of a curve there should be a cross connection between the tracks. Both the bottom and top of steep grades show a tendency to loosen the bond connections, and here special attention should be paid to the bonding.

The function of cross bonding is to equalise the conductivity of the two rails in case bonds are open in some part of the track. The general rule is to place the cross bonds every 500 to 1,000 ft., and have them connect all parallel rails.

In some soils, especially blue marble and red clays, supplementary wires should be protected from actual contact with the clays, as they show a tendency to rapidly corrode the bond wires, due both to the natural action of the soils and to electrolysis. Ground plates were largely employed in the early days of the return circuit construction, but while at first they give some assistance to the return circuit, they rapidly depreciate with age. In one case where a ground plate was employed, having an area of over 100 sq. ft., it carried 85 amperes when first installed; at the end of a month this fell to 14 amperes, and at the end of a year to only 3 amperes. The outlying ground plates from a track depreciate more rapidly than the negative or receiving plate at the station where the trolley is positive, and these ground plates from which the current leaves to earth have been found fairly well insulated after several months' use. Rails partly imbedded in the earth run as high as 10,000 ft. of contact surface per mile, which is enormously more than the area of contact of a ground plate, and the former surface is more effective as it is near the surface of the earth, where the earth is mixed with decomposed vegetable matter and the electrolyte adjacent to the rails is being continually replenished by rainfalls. Paving greatly increases this resistance, the concrete having a much higher resistance than the soils.

Return Circuit Testing.

In determining the conductivity of a ground return, the aggregate resistance of the return circuits should be obtained. Where the line is broken up by line circuit-breakers this can be done at any time, when the cars are not in operation, at each circuit-breaker point on the line. The method of making these connections for the determination of the ground return drop is diagrammatically shown in fig. 1.

The test car is sent out with a water rheostat, which carries from 100 to 200 amperes (an ordinary oil barrel will make such a rheostat) having iron plates from $12 \times 24 \times \frac{1}{16}$ in. in size, and the barrel being three-quarters filled with water, using bicarbonate of soda for reducing the resistance of the solution. Slats can be put across the rheostat, so as to prevent the plates coming in contact, and wooden chips can be floated on top of the water to prevent it from splashing when the car is running.

When the car arrives at the line-breaker C, the circuit-breaker to the section fed by B is opened, and the line side of this circuit-breaker is connected through the voltmeter to the ground bus. The most appropriate voltmeter for this purpose is one having a 500-volt scale and a 50-volt scale. The 500-volt scale is connected across the bus to see if there is any leakage into this feeder B, which is to be used as a pressure wire. Feeder B is connected to the rail by means of a hook and pole, and also furnishes current to five lamps in series which are bridged by a fuse wire and small 500-volt switch. When connection between the trolley wire and ground is first made, the lamps will burn until the circuit-breaker in the station at B is open. If the line is clear these lights go out, then the switch D can be closed including the fuse E; then, when the load is put on the line (which can be read either on the car by ammeter F or by ammeter G in the circuit of the feeder A at the station) this will include the current used by the lamps and the heaters in the car. Then the amperes of G divided into the voltmeter readings across feeder B to the ground bus will give the resistance of the return circuit at the point tested.

By concerted action—by plotting out in sequence the different points to be tested, and having the car not leave a given test point until the circuit-breaker at the station is opened—a considerable number of these ground returns are readily tested, and the relative resistance of the ground returns throughout different parts of the track determined. Those sections showing high resistance per mile require first attention.

There are a number of ways in which a joint-to-joint test can be made. One is to use a millivoltmeter across the joint and also across a portion of the adjacent rail; then by a double throw switch compare the readings of the joint with the rail. In paved streets, however, it is usually advisable to locate these bonds, which are

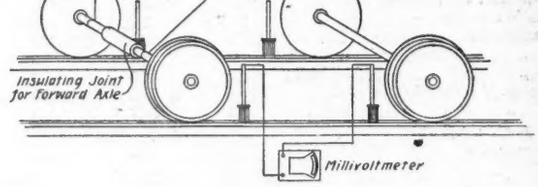


Fig. 2.

practically broken links in the return circuit to the station. This can be done in the following way, at the rate of about four miles an hour, while the road is in operation.

It is necessary to have two voltmeters reading about 300 millivolts full scale, provided with keys so that they can be snapped out of circuit in case an open bond is bridged for contact to the rails. I have found nothing better than wire track brushes, which can be made serviceable for this purpose by taking off the top of the brush and over the ends of the wire brush securing a copper plate, which will make contacts to the ends of the wires; to this solder the drop wire. The flexible vertical motion on these brushes gives sufficient pressure for these contacts, four of them being required, two on each rail. A wooden platform truck with four wheels, such as is usually found in railway construction, answers this purpose best. The brushes are then rigged up underneath this car, having 4 ft. between centres, two of them resting on each rail. Two pressure wires to each rail are carried back to the car, and the voltmeters are connected to them, one for each rail.

It is best to have a light car, for if a heavy car is used very often the weight of the car will cause the fish plate to make contact and bridge the broken bond. When this truck is towed over the line it should be between the operating car and the power station, for the reason that, if a dead rail is run over, the current will be deflected from the dead rail to the live rail through the axles of the car, and will show on the relative readings of the two voltmeters a different current flow in the rail. A light truck will not tend to assist in equalising the current flow on these two rails.

It will be noticed that when the brushes are over a solid rail, there will be a slight deflection given to the voltmeter hand; this deflection will suddenly jump up on passing over a bond, and it is necessary to run over the entire road to determine what bonds will be passed and what joints rebonded. This varies with the general character of the bonding and the current density in the rail.

A number of queer things will often be observed in these tests caused by broken bonds and effective cross-bonding. The current will sometimes be reversed where two broken bonds are found on one line of rail and the current from the car will flow through the cross-bonding back to the paralleling rails.

The best way of readily marking these poor bonds is to have an enclosed tank nearly filled with whitewash, and run two pipes towards the forward end of the platform, providing the ends of these pipes with quick trip valves, and having a string to each valve. If the car is provided with an air brake, the air pressure from the brake reservoir can be piped to the top of this tank. When a bad bond is reached pull the cord on the trip valve and the whitewash will be squirted over the side of the track near the defective bond. This whitewash will last several weeks so as to allow plenty of time to replace the bond, and does not interfere in any way with the running of the car.

This test requires two observers, one on each rail, to make it properly, with a speed of from 4 to 6 miles per hour. Fig. 2 shows the general arrangements of the trailing bond test car. It must be made so that the bond is compared against the actual current density in the rail, which can be determined very closely from the weight of the rail and the drop of the voltmeter, by using the following data:—The resistance of one mile of continuous rail 1 sq. in. in section equals 0·45 ohm; or the resistance of the rail is practically 10·4 times that of an equivalent section of pure copper at 20° C.

CURRENT SPECIFICATIONS.

LXXIII.—BLACKBURN EXTENSIONS.

SUMMARY.

Extent of Contract.—Supply and erection upon prepared foundations of *three* 775-kw. steam dynamos.

Engine.—Triple-expansion high speed, though it is stated that full consideration will be given to alternative offers with other types of engines if accompanied with full specifications.

Specified Speed.—Not to exceed 180 revolutions per minute.

Governor.—Permanent variation when whole load thrown off not to exceed 1½ per cent., and temporary throw under similar conditions not to exceed 2½ per cent. May be either throttle or automatic expansion type.

Dynamo.—To be of multipolar type, suitable for either lighting or traction work.

Output.—A shunt machine 775 kw., 1,615 amperes at 480 volts, but voltage to be variable at constant speed between 460 and 500 volts. A compound machine in use for traction work to maintain a contract voltage of 525 volts at terminals at contract speed with any current between 500 and 1,476 amperes.

Overload.—To be capable of maintaining for periods not exceeding 30 minutes a current of 1,850 amperes at 525 volts = 25 per cent. over normal rating.

Permissible Temperature Rise.—With current of 1,615 amperes at 480 volts, temperature rise, measured thermometrically, not to exceed 60° F. after six hours' run.

Steam Consumption.—To be stated by tenderer for full and half-load when working condensing with 24-in. vacuum.

Specified Date of Delivery—First two sets by September 1st, 1902, the third set by August 1st, 1903.

Penalty for Late Completion.—£20 per week.

Terms of Payment.—75 per cent. of value of work executed or plant delivered on site as work proceeds, 15 per cent. on satisfactory completion, 10 per cent. 12 months later.

Period of Maintenance.—12 months from date of completion.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be paid to Workmen.—Standard rates to be paid, and usual conditions of labour observed.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—August 6th, 1901.

This specification is signed by Mr. A. S. Giles, the borough electrical engineer, as well as Messrs. Lacey, Clirehugh & Sillar, the consulting engineers to the Corporation of the County Borough of Blackburn.

It asks for the supply and erection upon prepared foundations of three 775-kw. steam dynamos, an evidence of the growing importance of the electrical supply industry, for a few years ago plant to the aggregate output of one of these units would have been considered a very important addition to the generating capacity of any central station.

These units are to be suitable for use on either lighting or traction circuits, the engines being preferably three-crank triple-expansion. The steam pressure available is 170 lbs. per square inch, and condensing facilities are provided under another contract, so that there should be no difficulty in obtaining with triple-expansion working extremely economical results. If tenderers prefer to offer other types of engines, provided they supply full specification of same, they will be carefully considered.

The dynamo are to be of standard multipolar pattern, and capable of developing as shunt-wound machines, 1,615 amperes at 480 volts, as compound-wound machines the output is to be 1,476 amperes at 525 volts, and the 25 per cent. overload demanded for 30 minutes is to be calculated upon the current carried at 525 volts, making the overload current 1,850 amperes.

The temperature rise permissible is 60° F. above surrounding atmosphere measured by means of thermometers after six hours' run with 1,615 amperes in circuit, the flashing test specified is 2,000 volts alternating applied for one minute, and suitable shunt resistances for controlling the voltage when working as shunt machine between 460 and 500 volts are to be provided.

One of the sets is to be erected and tested for steam consumption at full and half-load at the engine builders' works, but if this proves satisfactory, and the figures obtained are within those guaranteed in the tender, the remaining two may be erected direct on site. In this case a six-hour test for governing, insulation, and combined efficiency will be taken after erection.

Tenderers are also asked to state the highest degree of superheat at which they will guarantee that the engines they offer will work satisfactorily.

The general conditions are the same as those issued when the specifications for the main contracts for the equipment of the station were issued in 1899.

They are, on the whole, of a satisfactory character, and may be accepted by any tenderer without undue risk. The arbitration clause is somewhat limited in its application, but the points reserved for the final decision of the engineer are of simply a technical character; apparently any disputes involving alterations to the contract price are, in the last resort, subject to arbitration.

It is stipulated that standard rates of wages, as recognised by both trades union and employers' association for the district in which the work is carried out, shall be paid, and the usual conditions of labour and hours of work observed. In case of any misunderstanding on this matter the question in dispute is to be referred to a joint committee of the two associations for final decision. This course has become popular in the North of England, largely on account of its successful working in the various textile industries so largely carried on in that part of the country.

ELECTRO-CHEMICAL INDUSTRIES.

[Abstract of the presidential address delivered before the Society of Chemical Industry at the annual general meeting, Glasgow, July 24th, by J. W. Swan, F.R.S., President.]

The nineteenth century will be for ever memorable for the great scientific discoveries it produced, and the wonderful development that took place during its progress in the applications of science to industrial uses in relation to chemistry and electricity. In the first decade the marvellous analytic power of electricity was fully realised, and we became familiar with the heat-producing effects of the electric current. The three succeeding decades show no sensational discovery, but they yielded many indispensable developments and extensions of what had already been partly attained. Above all, they produced the work of Faraday, who laid down with great exactness most of the laws of electro-chemical action. In the fifth decade came Faraday's discovery of magneto-electricity, concurrently with the demand for pure copper for submarine telegraphy, and other inventions which called for cheaply produced electricity. Since that time striking developments have taken place in electro-chemical industries. There are now over 150 firms in Europe alone applying electricity to the manufacture of chemical and metallurgical products.

Copper Refining.—The total production of raw copper in the year 1900 was 486,084 tons, to which total the United States contributed 268,787 tons. The latest published estimate of the proportions of these totals refined by electrolytic methods, gives roughly 172,000 tons for the American refineries and 37,000 tons for the 27 refineries located in our own country and on the Continent. My own inquiries would seem to indicate that the European production of electrolytic copper is now less than 37,000 tons a year.

In copper refining the power element of cost is not vital, and with skilful arrangements and the use of large depositing tanks for a given output, the cost of power, even when coal is used to produce it, is not the chief item in the total cost of the process. Hence, this is one of the electrolytic industries that it is possible to carry on successfully in a country like ours, which is not largely supplied with water-power.

Not only is the electrolytic process more economical, because it requires little power and little labour, and because the precious metals found as impurities in the copper are more completely recovered, but the purity of the product is much greater than that resulting from the old process of refining, and when the copper is required for the purpose of an electrical conductor its money value is enhanced in proportion to the increased purity.

At present 300,000 tons, or over 60 per cent. of the total output of copper, is utilised in electrical engineering. This demand is almost wholly the growth of the last 15 years, and it is rapidly increasing.

The saving due to the higher conductivity obtained, and to the more complete recovery of the precious metals, at a moderate estimate exceeds 1½ millions sterling per annum.

It has been attempted, with considerable success, to deposit the metal in such forms as to render unnecessary the extra process of fusion. The chief hindrance to the direct production of the electrolytic deposits in the finally required form, is the strong tendency of the copper deposited to be crystalline and rough and deficient in strength. Elmore has met this difficulty by causing the deposit to take place upon a revolving cylindrical surface against which an agate burnisher presses. The burnisher has imparted to it a slowly reciprocating lateral movement, which, combined with the rotary movement, results in the entire surface of the cylinder being repeatedly traversed while it is receiving the deposit. Cowper-Coles has employed rapid rotation of the cylinder in the copper solution, and in this way has obtained favourable results. A third method is the Dumoulin process, in which specially prepared strips of skin supply the friction necessary for obtaining dense and homogeneous deposits.

From experiments I made many years ago, I ascertained that it was possible, by varying the composition of the depositing solution, to suppress almost completely the common tendency to a strongly crystalline character of deposit, and to obtain deposited metal comparable to wrought copper in smoothness, hardness, and elasticity. A most remarkable effect was produced by the addition of a minute proportion of a solution of gelatine in dilute nitric acid, to an ordinary copper sulphate solution composed of a two-thirds saturated solution with 5 per cent. of sulphuric acid. If so much of the gelatine solution as represents one part of gelatine to 30,000,000 parts of the copper solution be added, instead of the deposit being pliant and crystalline, it will, under the proper conditions of temperature and current density, be smooth, bright, and elastic, and if the gelatine be in excess the deposit will be extremely hard and brittle.

The usual slow rate of electrolytic copper deposition (necessary where the object is pure copper of the highest conductivity) is often a serious limitation to the utility of a most beautiful process. But considerable gain in speed can be obtained by working at a higher temperature, and employing a highly metallised solution of

low specific resistance, coupled with the use of means for obtaining rapid diffusion of the electrolyte at the cathode surface.

Bullion Refining.—Electrolysis has been also applied with advantage to the parting of gold and silver, and to the refining of base bullion.

Silver bullion is refined at Frankfort by the Rossler or Gutzkow process, at Pforzheim by the Dietzel process, and at Hamburg by the Moebius process. Nitrate of silver or the corresponding copper salt is used as electrolyte, and the gold is recovered from the slimes by chemical methods.

At Hamburg gold bullion is refined by the Wohlwill process, which depends upon the use of an acid solution of gold chloride. The silver and platinum pass into anode sludge, and are recovered by chemical methods. The value of these recovered "impurities" helps to pay for the cost of treatment, and, in particular cases, more than covers it.

Bullion refining by electrolytic methods is finding extensive use in America, and at the Guggenheim refinery at Perth-Amboy a plant for refining silver by the Moebius process, having a capacity of 100,000 ozs. of silver per day, has recently been put in operation.

Electroplating.—The magneto-electric machine was patented by Woolrich in 1842, and the first machine built was used by Prime, of Birmingham, for electroplating. Messrs Elkington 60 years ago obtained a patent for electroplating and gilding by means of cyanide of potassium solutions of gold and silver. During all the progress of later years in other branches of electro-chemical industry there has been little or no change in this. The solutions as patented by Elkington are identical with those in general use at the present day.

The deposition of iron on copper is mainly employed for preventing the wear of engraved copper plates. The steely hardness of the thin coating, which is nearly pure iron, except for occluded hydrogen, is very remarkable. The plating of small articles with nickel has now grown into a considerable industry. Electrolytic coatings of cobalt, platinum, and palladium have also been quite successfully applied to other metals as protective coatings, but, so far, no great use has been found for them.

Aluminium.—The production of aluminium by electrolytic processes has now been in successful operation for 11 years, and the results are the total extinction of the chemical method and the reduction of the selling price of aluminium to between 1s. and 1s. 6d. per lb. The output last year has been estimated at about 6,000 tons. This is divided between Europe and America in the proportion of two to one.

In the iron and steel foundry the addition of a small amount of aluminium, the moment before casting, serves to remove any oxygen the melted metal may hold in combination, and consequently to increase the fluidity of the metal to be cast. The heat of combination, moreover, is sufficiently great to sensibly raise the temperature of the melted metal. I am unable to give figures showing the amount of aluminium used for this purpose, but it is undoubtedly one of the chief outlets for the metal at present. Probably the next most important use of aluminium is as an electrical conductor in lieu of copper. This application of aluminium has hitherto been chiefly confined to America, where several hundreds of miles of bare aluminium overhead transmission lines have been erected. Whether aluminium will prove as resistant to atmospheric corrosion as copper, time alone will show. Experimental trials of aluminium for similar purposes have also been made on this side of the Atlantic, but so far the results are not decisive. In the Glasgow Exhibition the overhead wiring of the outside arc light installation has been undertaken by the British Aluminium Company, with metal made at Foyers.

This rivalry between aluminium and copper, even if it be only a limited rivalry, may prove a salutary check on the price of copper.

Sodium and Magnesium, &c.—The sodium industry affords another instance of the displacement of an old and purely chemical process by an electrolytic one, on the sole ground of the greater economy of the electrolytic method.

The principle of Castner's sodium process is exactly like Davy's—in both the electrolyte is fused sodium hydrate. An iron pan with a fire under it contains the fused sodium hydrate. The cathode passes up into this vessel through an opening in its base, and both it and the annular anode which surrounds its upper portion are, I believe, formed of nickel. A strong current is employed, which helps to keep up the temperature of the electrolyte to fusion point. The sodium is released as liquid metal, and rises to the surface of the fused soda, means being taken to remove it and to prevent its combustion on coming in contact with the air.

By this process sodium is now manufactured by hundreds of tons, and passes into commerce partly in metallic form, chiefly for use in the cyanide manufacture, but a considerable portion is converted into peroxide of sodium. The total output in 1897 was 260 tons.

In the extraction of magnesium also, the electrolytic method has superseded the chemical method. The process is analogous to that used for the extraction of sodium.

A process of electrolytic zinc extraction, in which chlorine as well as zinc is produced, is in successful operation at Winnington. The process is based on the patents af Hoepfner, and a considerable quantity of extremely pure zinc is the result.

The Hoepfner process for treating nickel-copper ores and residues is operating at Papenburg in Germany. The production towards the end of 1900 was stated to be at the rate of one ton of nickel per day.

Dr. Mond has estimated that the total consumption of nickel is now 9,000 tons per annum, and the new Clydach works in South Wales, where his most beautiful nickel carbonyl extraction process is about to be worked, are designed to produce 1,500 tons of nickel per annum.

Gold Recovery from Cyanide Solutions.—The lamentable war in South Africa has caused the suspension of all mining operations for nearly two years, and consequently no very recent statistics of this process are available. On January 1st, 1898, it was stated that 13 works in the Rand district were using Siemens & Halske's process, and that 12 others were about to adopt it. Pauli, in the same year, estimated that 88,000 tons of tailings and 46,000 tons of slimes were being treated monthly by this process.

The Electrolytic Alkali and Chlorine Industry.—For obtaining chlorine and sodium, or chlorine and soda, no process can, theoretically considered, be more beautifully simple and complete than the electrolysis of chloride of sodium. But when an attempt is made to carry out this form of decomposition on an industrial scale, a number of perplexing practical difficulties present themselves.

Greater success has attended the employment of aqueous solutions of common salt as the electrolyte for the production of alkalies and bleach. The forms of apparatus employed have not yet settled down to a uniformity of type such as obtains in the competing chemical processes; and there is much obscurity concerning details of the processes employed at several of the Continental electrolytic alkali works.

I may, however, state that there are two well-marked types of cell employed in the electrolysis of brine for production of alkalies and chlorine. One is the type in which mercury is used to amalgamate with and separate the sodium or potassium set free at the cathode, and to remove it from the area of electrolytic or chemical reactions within the primary cell. In the other type of cell a diaphragm is used to divide the anode and cathode compartments, and the chemical reaction, by which the metal is transformed into the hydrate, is, as far as possible, restricted to the cathode compartment.

With respect to the first type of cell, two forms are in actual use, and are working with satisfactory results, namely, the Castner-Kellner and the Solvay cells. At the Castner-Kellner Company's works at Weston Point, I saw in full operation a chemical works employing 4,000 H.P., and yielding a large output of very pure soda and very strong bleaching powder, and also a large quantity of sodium and its products, without creating any kind of nuisance. The ashes from the engine furnace, and a little thin smoke from the chimneys, were the sole products in the nature of refuse. The solid contents of the brine, brought into the works by a pipe from the neighbouring salt beds, were wholly transformed by steam-power into valuable products. The bleaching powder plant covered two acres. I believe it is the largest in the world.

One of the best known of the diaphragm type of cell is that devised by Hargreaves and Bird. The success of an experimental plant led to the erection of a large factory at Middlewich, in Cheshire. On the occasion of a recent visit to these works, I saw a double series of 11 large cells in operation, each cell taking an E.M.F. of nearly 5 volts, and a current of 2,000 to 2,500 amperes. The product here is not caustic, but carbonate of soda, and bleaching powder.

Asbestos, and Portland cement rendered porous by the admixture of various salts during setting and subsequent lixiviation, have both been successfully employed as the material for the diaphragms.

Other diaphragm processes in actual operation are the Outhenin-Chalandre and the Le Sueur processes.

Although the principle of cell construction, in which gravity is allowed to effect the separation of the sodium hydrate formed at the cathode, and in which, therefore, a diaphragm or mercury is dispensed with, has been discredited, a cell on that principle is said to be working with satisfactory results at Aussig, in Austria, and, according to Hausserman, this works is producing alkalies and bleach at the rate of 2,640 tons per annum.

A recent laboratory research by Adolph has shown that, under carefully regulated conditions, a current efficiency of over 80 per cent. can be attained in these cells with continuous work; and as the saving in cell construction and E.M.F. is considerable, it is possible that "gravity" cells may once again come into use.

There are now 23 electrolytic alkali works in operation in Europe, disposing in the aggregate of 50,000 H.P.

Hypochlorites.—There are a very large number of firms in Europe using electrolysis for the production of bleaching solutions containing sodium hypochlorite. The principle of the method employed is common to all, and depends upon the chemical action that takes place when chlorine gas is passed into a solution of sodium hydrate at a temperature below 20° C. The solution obtained may contain up to 10 grms. available chlorine per litre. Bleaching liquids prepared in this way are being utilised in the textile and wood pulp industries of the Continent to an increasing extent. I am informed that 1,600 H.P. is being utilised in Southern Germany by one form of apparatus alone.

Chlorates.—There are five different types of cell now in operation for the production of electrolytic chlorates; as in the case of hypochlorites, the principle of the method employed is the same in all cases. The diaphragm principle is still employed in the original process of Gall and Montlaur, but elsewhere this feature appears to have been abandoned.

The number of works producing chlorates by the electrolytic method is now 10, seven of these being in Europe, and 28,000 H.P. is available for this manufacture. The prices of chlorate have fallen greatly since the electrolytic process was adopted on a large scale. Whereas 10 years ago chlorate of potash was selling at 6d. per lb., it is now quoted at only 3½d.

Organic Products.—The following organic compounds have been produced in the chemical laboratory by aid of electrolytic methods:—

Iodoform, vanillin, chloral, azo and hydrazo compounds, oxidation product of fusel oil, dyes of triphenylmethane type, aniline

blue and aniline black, Hofmann violet, alizarine, Congo red, oxidation products of the alcohols, sulphonic acids, piperidine, dihydrochinoline, benzidine, amidophenol.

In all factories where organic products are made on a large scale, chromic acid is the usual oxidising agent.

The electrolytic production of inorganic colouring matters has not developed into a recognised industry, but I am informed that there is a firm at Cologne producing white lead and other chemicals of this kind by electrolysis.

Ozone.—In the field of organic chemical manufacture ozone has been utilised with great effect, especially in the transformation of oil of cloves into vanillin and into heliotropine, also in bleaching operations in conjunction with hypochlorite of soda. I am informed that the quantity manufactured yearly of these two valuable substances amounts to 10,000 kilos., and that 350 H.P. (steam) is used in their production.

Among the more important uses proposed for ozone, the sterilisation of water must be mentioned as occupying the attention of hygienic engineers. The principle has been definitely adopted for the water supply of Lille. The decolouration and defecation of syrup in the sugar manufacture, and the rapid production of the effect of "ageing" on alcohol, are among the many other uses proposed for electrically produced ozone.

The Fixation of Atmospheric Nitrogen.—At the Bristol meeting of the B.A. in 1898, Sir William Crookes pointed out the great possibilities latent in atmospheric air as a source of nitrates for the fertilisation of the soil.

Basing his calculations on figures given by Lord Rayleigh in 1897, Sir Wm. Crookes found that 14,000 B.T.U. would yield sufficient nitric acid to form one ton of nitrate of soda; and that at Niagara this quantity of energy would not cost more than £5. Since then Messrs. McDougal and Howles have obtained even better results. The following extract gives the best results so far obtained:—

"An experiment was conducted with a mixture of oxygen and nitrogen in the proportion of two to one. The gaseous mixture was passed through the apparatus at the usual rate. A quantity of acid almost double that previously obtained (that was when atmospheric air pure and simple was used), amounting to 590 grms., was produced." With the same power and time, viz., 12-H.P. hours, Lord Rayleigh's result was only 440 grms.

The manufacture of nitrate of soda in this way is still undeveloped industrially. The idea is nevertheless alluring, for surely chemical science and chemical industry can be put to no higher or fitter use than to help to increase the fertility of our fields. If the quantity of nitric acid produced per KW. of power expended can be increased yet a little further—and such a development seems to be far from hopeless—this immense application of electricity will become profitable. The subject is certainly worthy of the serious attention of chemists.

The Electric Furnace.—Sir William Siemens exhibited his electric furnace in action before the Society of Telegraph Engineers in June, 1880, and lucidly pointed out its many advantages. The employment of electricity in this way to generate extremely high temperatures has, within the last 10 years, been greatly developed. Yet it may be anticipated with much confidence that the industrial use of the electric furnace has not nearly reached its practical limit.

Regarded from a narrow point of view, to carry on a chemical process by electric heating seems, at first sight, of all methods the most wasteful. As we all know, in generating heat electrically, so many energy-expending transformations have to be passed through, that only a small fraction of the whole energy expended is finally effective in the furnace.

But when at last you have obtained your electrically produced heat, you obtain it in a form so convenient for applying to the exact place where it is wanted that, in many cases, the wasteful mode of production is more than compensated for. For example, in the reduction and distillation of zinc by the process in general use, it is not uncommon to consume 5 tons of fuel in producing from the ore 1 ton of metal. If the statement lately made in a foreign journal in relation to the electrical extraction of zinc be true (and I see no reason to doubt it), only 2 tons of fuel would be required if the power had been generated by an economically working steam engine employed to generate electricity, to be afterwards transformed into heat and properly applied to the reduction of a mixture of calcined ore and carbon in the electric furnace.

The electric furnace not only has the merit of making very good use of the heat developed in it, but it has the further merit that much higher temperatures are attainable than in ordinary furnaces; consequently a new group of high temperature products has been brought within the range of industrial use by its means.

The most conspicuous members of this new series of electro-chemical products are calcium carbide, carborundum, and artificial graphite. All these demand temperatures for their formation so high that their industrial production is only possible by means of the electric furnace. Electric heating has also several advantages in the reduction of the more refractory metals and their alloys.

In the hands of Moissan the electric furnace has proved a most effective instrument of chemical research.

Calcium Carbide.—After electrolytic copper refining, there is no branch of electro-chemical industry so large as that of calcium carbide. I am credibly informed that the European production in 1900 was about 60,000 tons, and that works exist with power to produce three times this amount, if the demand and price warranted such an increase of production.

In nearly every case the power by which the electric heat is generated is derived from water, and the only considerable production of calcium carbide in Britain is at Foyers, where there is a factory for the production of between 2,000 and 3,000 tons a year

Of late there has been most serious disproportion between the supply and the demand, with the result that only those factories that are most favourably situated in relation to cost of power and raw material, and also cost of carriage of the product to the place of consumption, have been able to carry on the manufacture with profit. Calcium carbide is not well able to bear long and difficult carriage. Not only has the immediate cost of carriage to be considered, but also troublesome restrictions of freedom of transport These restrictions tend to embarrass and lessen manufacture. The anticipations of an almost unlimited demand have not been realised, and there are in consequence many carbide works idle, with water running to waste, and fully equipped power plants ready to be applied to some more immediately profitable use.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

14,349. "Safety guard for electric cars, motor cars, and such like self-propelled vehicles." A. E. P. Hill. July 15th.

14,367. "Improvements in or relating to, and in the manufacture of, elements for electric storage batteries or accumulators." J. T. Niblett. July 15th.

14,376. "Improvements in and connected with electric bell pushes and like switches and other articles." W. G. Hicks. July 15th.

14,404. "Improvements in electric switches." H. H. Lake. (W. P. Pinckard, United States.) July 15th. (Complete.)

14,411. "Improvements in and relating to the manufacture of filaments and other conductive bodies for incandescent electric lamps and heaters." W. E. Sander. July 15th. (Complete.)

14,423. "A combined telephone, telegraph, electric light and power system." A. M. Stark. July 15th.

14,429. "An improved label for electric tables, pipes, or other cylindrical bodies." C. Beckingeale. July 16th.

14,466. "Improvements in electrical storage batteries or accumulators, and in electrolytes for electric batteries." P. Stiens and P. J. Smith. July 16th. (Complete.)

14,474. "Improvements relating to electric batteries." A. E. Greville. July 16th.

14,486. "Process and apparatus for the manufacture of wrought-iron, steel, and cast-iron by electric heating." J. Imray. (La Société Electro-Metallurgique Francaise, France.) July 16th.

14,488. "Improvements in means for the electric lighting of railway trains, tramcars, and the like." C. Jacquin. July 16th.

14,490. "Improvements in electric lamp hangers." H. J. Harrison. July 16th. (Complete.)

14,511. "Improvements in electric light apparatus for medical purposes." A. W. Marshall and M. W. Woods. July 16th.

14,533. "Improvements in and relating to electrical instruments for transmitting sounds, writing, and drawings." E. J. Clifford. July 17th.

14,551. "Improvements in suspension gas lamps, chandeliers, brackets, electric light fittings, and the like." F. H. Barwell, H. Barwell, H. P. Kimberley, and J. F. Smith. July 17th.

14,562. "Improvements in alternating current electricity meters." F. L. Catenhusen. July 17th. (Complete.)

14,579. "Improvements in and relating to the transmisson of electrical energy." H. H. Lake. (N. Tesla, United States.) July 17th. (Complete.)

14,589. "Improvements in life guards for electric cars and like vehicles." W. Preston. July 17th.

14,611. "Improvements in tunnel casings for electrical railways and other purposes." G. H. Lloyd. July 18th.

14,614. "Improvements in trolley heads for electric cars, &c." J. Hunter and E. Griffiths. July 18th.

14,624. "Improvements in moving coil electrical measuring instruments." A. Eckstein and F. Panter. July 18th.

14,643. "Electric furnace arranged for being oscillated or clipped." J. Imray. (La Societe Electro-Metallurgique Francaise, France.) July 18th.

14,656. "An improved automatic cut-out device for overhead conductors." T. W. Renwick and J. Grant. July 18th.

14,670. "Improvements in connection with electric circuits." A. H. Howard. July 18th.

14,700. "Improvements relating to electrical speed indicators." R. F. Collings. July 19th. (Complete.)

14,733. "Improvements in apparatus for lighting gas by electricity." H. Nehler and F. Nehler. July 19th.

14,751. "A process of electro-metallurgic treatment of ores of copper and other metals with de-polarised insoluble anodes." C. J. Tossizza. July 19th.

14,813. "Improvements in or relating to trolleys and like current conductors for electric railways and tramways." G. A. Menlove. July 20th.

14,822. "An improvement in electrolytic apparatus." J. G. A. Rhodin. July 20th.

14,825. "Electro-metallurgical treatment of zinc ores and especially blend." C. J. Tossizza. July 20th.

14,826. "Improvements in apparatus for exhausting electric glow lamps." O. Imray. (P. Scharg, Germany.) July 20th.

14,827. A magneto-microphonic electric transmitter." O. Lugo and J. A. Barratt. July 20th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

21,844. Improvements in portable telephone apparatus." H. C. L. Holden. Dated November 1st, 1899. Portable telephonic apparatus is mounted in a box divided into two parts by a partition on which the terminal block is mounted.

One part contains the battery and the other part the magnets, induction coil, and bell coil, all combined and fixed by two screws. The instruments are mounted on a switch handle having a removable portion to facilitate repair. The case is fastened by means of extensions from a folding handle, which engage under studs on the ends of the box when the handle is raised into position for carrying. 2 claims.

21,886. "Improvements in connecting-plugs for electrical switchboards." A. T. M. Thomson and P. Warnford-Davis. Dated November 1st, 1899. The cord carrying the connecting wires is passed into a plug through a lateral hole. The sides of this passage are preferably inclined so as to prevent a sharp bend. An indicator which may consist of a lamp or suitable disc, is fitted at the end. It is preferably contained in a removable cap secured by a screw. In the form described, the plug is a three-way plug, and the cord has two wires, but these numbers can be varied as desired, *e.g.* a two-way plug would be connected up to a cord with three wires. 7 claims.

21,968. "Improvements in arc lamps and roller-clutch mechanism for feeding and controlling the electrodes therein." H. H. Leigh. (T. E. Drohan.) Dated November 2nd, 1899. The upper carbon is loose in a vertically movable tube carried by the core of a series solenoid. A split block is clamped on the tube and has an inclined slot to contain a lava or other insulating roller made with end flanges to keep it in place. The axle of the roller engages slots in a bifurcated lever, which is pivoted to the block. When the tube rises, the roller descends in the inclined slot and bears against the carbon, gripping this in the tube, and lifting it to strike an arc. When the tube descends, the lever comes in contact with a stop and holds up the roller permitting the carbon to slip. 10 claims.

22,020. "Improvements in or relating to telegraphy without the use of continuous wires." W. P. Thompson. (F. Braun.) Dated November 3rd, 1899. Relates to wireless telegraphy in which the spark gap is arranged in the primary of a transformer, the secondary being connected to earth and aerial conductor. A Leyden jar is used as a generator, but an induction coil may be employed. 1 claim.

22,028. "Improvements in or connected with electrodes for electrolysers." R. Eycken, R. Moritz and C. Wasquehal. Dated November 3rd, 1899. The electrodes are of two kinds, those formed of materials capable of being cast, moulded, or shaped easily, and those formed of other materials, such as carbon. Each kind is formed of two parts—(1) the base or carrier, and (2) the electrode. In the first class, the base consists of a plate with a smooth rim, and with a deep cross groove or canal at the top, and at the bottom joined by rows of furrows of any shape in cross-section. The electrolyte enters the bottom canal, passes through the furrows, and leaves by the top canal. This base may be a good or a bad conductor. When the electrolyte is to be heated, a pipe coil is embedded in the mass of the plate; or hollow plates may be used. The electrode itself is a wire netting, or a corrugated or perforated sheet-iron or steel plate. If the wire netting has thick wefts, then the furrows may be omitted. The base may be a cast-iron rim or frame enclosing a piece of corrugated metal, which takes the place of the furrows and upon which the wire netting is placed. The canals are in this case formed in the frame. In the second class, the base consists of an insulated or insulating frame, with holes in the top through which thick carbon rods are passed downwards nearly to the lower member of the frame. Openings are provided for the admission and discharge of the electrolyte. The electrode itself consists of thin carbon rods of round polygonal or other cross-section, held by means of asbestos fabric in contact with the thick rods. They reach from the bottom member of the frame nearly to the top one. The electrodes of both classes may be constructed with only one active face or with two active faces. They may be formed cylindrical, prismatic, or of other shape instead of flat. To form a cell two electrodes are placed together, with or without an intervening diaphragm. The electrolyte is circulated rapidly so as to prevent polarisation. The pressure on the two sides of the diaphragm may be varied so as to facilitate the passage of liquid through the diaphragm. A current of low density is used. The particular combination of electrodes and diaphragms is for use in electrolysing an alkaline chloride to produce alkali and chlorine. When intended for preparing hydrogen and oxygen by electrolysing a caustic soda solution, both anode and cathode are formed of wire netting, but when electrolysing sulphuric acid for the same purpose, both are formed of carbon. The apparatus may also be used for purifying a solution of aluminium sulphate from iron or for organic oxidation or reduction. 5 claims.

22,081. "Improvements in and connected with micro-telephones." S. Schiff. Dated November 4th, 1899. Portable instruments consisting of a receiver and transmitter are connected by two metal bars forming the electrical connections between the two instruments. The transmitter is provided with a plug connection, and has a push set in the back for making the calling connection. The connections are made by metal plates in the interior of the casing, and the carbon block is set in metal screw ring connected to one of the terminals. The diaphragm is protected by a perforated screen. 1 claim.

22,088. "Improvements in incandescent electric lamps." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated November 4th, 1899. A filament consists of a refractory core, conductive at ordinary temperatures, enclosed in material which conducts only at a high temperature. The core may be carbon and the covering lime, the core being converted into calcium carbide when the filament is rendered incandescent; or the core may be made of a mixture of carbon and lime. The filament may be of ordinary loop form, with a central supporting wire, and mounted in a bulb which is either exhausted or open to the atmosphere. 6 claims.

22,102. "Improvements in or relating to electric cables." J. Y. Buchanan. Dated November 4th, 1899. Conductors or cables are insulated by alternating layers of gutta-percha and a mixture of india-rubber and ozokerit. Any number of layers may be employed, gutta-percha being the innermost and outermost. Resinous gutta-percha and a small amount of shellac may be added to the india-rubber and ozokerit mixture. 2 claims.

22,107. "Improvements in electric alarm water-level indicators for steam boilers and the like." M. L. Bush and C. F. Swain. Dated November 4th. (Date under International Convention, April 8th, 1899.) Relates to electric alarm water-level indicators for steam boilers and the like, which will remain at rest except when the water rises or falls beyond the prescribed limits. A float and a weight are suspended from a counter-balanced lever arm in a cylinder with capped ends, which is connected above and below with the boiler. When the water rises it lifts the float, and when it falls below the weight the latter overcomes the counter-balance weights. The lever arm is mounted on a rocking spindle, which passes through a stuffing box and carries outside, horizontal and pendant arms to receive counter-balance weights, and a vertical electric contact arm. The arm carries a divided spring head, which makes contact on either side with terminals, thus closing the circuit of an electric bell or other alarm. The form of the head causes a scraping contact between its spring heads and the terminals which will remove dirt. 3 claims.

22,143. "Improvements in electrical accumulators." E. C. H. T. Lugard. Dated November 6th, 1899. Relates to frames and grids for supporting the active material, and consists in providing the strips which form the border of the frame and other strengthening strips with ribbed faces in order to hold the active material more securely in place. The ribs or ridges are formed by making the aforesaid strips of less thickness than the horizontal strips, and by continuing the small horizontal strips across the strengthening strips. 1 claim.

22,163. "Improvements in continuous current electricity meters." E. Schattner. Dated November 6th, 1899. In an electrolytic meter, an anode or cathode or an electrolyte receptacle, or a gas bell, or the whole voltameter is directly supported by the movable part of a spring balance, or equivalent continuously-registering apparatus, such as an iron counterweight dipping in mercury and connected by a pulley, or otherwise with a dial indicator. The electrolytic cell is connected in parallel with a resistance; it may be a copper cell containing a copper plate and sulphate solution. 4 claims.

22,164. "Electro-magnetic ignition device with revolving armature for gas, petroleum and similar motor engines." W. P. Thompson. (F. Sturm.) Dated November 6th, 1899. revolving, instead of an oscillating, armature is used in conjunction with ma et for roducing electric sparks for igniting. Contact in the cylinder is broken twice for every revolution of the armature by apparatus operated by a double crank on one of the trunnions; the other trunnion carries an insulated axial conductor which bears against the collector. 1 claim.

22,257. "Improvements in or relating to means for mounting electric lamps on signs, letters and other articles and surfaces." G. A. Harter. Dated November 7th, 1899. The holders for electric incandescent lamps are formed integral with the article, such as letters, signs, &c., to which the lamps are to be attached. A mould is described in which the electric wires and contacts and other fittings are placed ready for the plastic material to form the holders to be moulded around them. Around the pegs which form the recesses for the lamps the wire is coiled, so that, when the pegs are with drawn, the coils serve as screw-threads to hold the lamps. A wire is looped around the pins by which the pegs are held. A modification is adapted for a different kind of lamp, in which the wires are secured to contracts, which are separated by an insulating board. 8 claims.

22,260. "Improvements in electrically operated governors, chiefly designed for regulating the speed of dynamos or motors." H. H. Lake. (J. B. Millet.) Dated November 7th, 1899. Relates to centrifugal governors for dynamos and motors, by which the speed may control either the supply of current in the field or armature of the motor, or may control the valve of a steam engine by means of an electro-magnet in a local circuit. The governor is described as applied to ringing a bell by means of internal magnets excited by two-phase alternating currents. The sleeve is mounted on the shaft to rotate with it, but to be capable of slight longitudinal motion. A ring is mounted on sleeve and has a light arm insulatingly piloted therein. The arm plays between contacts and is held against centrifugal action by a spring attached to one end of the lever, the other end of which is pressed against by the axial adjusting-screw mounted on a bracket. Contact rings are insulatingly mounted on the sleeve, and are rubbed by brushes in the controlling circuits. 5 claims.

22,271. "Improved manufacture of electrical heating appliances of high electrical resistance capable of sustaining high temperatures." A. Vogt. Dated November 7th, 1899. Resistances capable of sustaining high temperatures are moulded from mixtures of very finely powdered metals and refractory non-conductors, with water or other liquid, and may be pressed in moulds to produce uniform results; they are dried, and then heated in hydrogen, at first to a temperature only sufficient to completely reduce the oxide on the metal particles. This having been done, the temperature is raised to the welding temperature of the metal, so that the non-conducting constituent frits, still on the hydrogen atmosphere, carbon being carefully excluded. The materials used may be nickel, cobalt, or wolfram, with kaolin, talc, alumina, quartz, or other oxides or rare earths. The heating bodies produced are applicable for heating bodies requiring preliminary heating to render them conductive, and branding dies, for lighting cigars and pipes or other purposes. 2 claims.

22,291. "A new or improved system of telegraphy." J. G. Lorrain. (F. Bedell.) Dated November 7th, 1899. Relates to systems of submarine or other telegraphy, in which the signal currents consist of waves or pulsations rising and falling from a minimum, the line being earthed between each signal or group of signals. The rise and fall of the current strength may be uniform or varying by means of unequal battery section or by unequal contact-sections as shown in the distributors. The use of + and − currents is shown, but two current values of the same sign may be employed. A central row of perforations is for earthening the line through the brush. In a modified form, a single line of perforations is employed for earthing the circuit, which otherwise receives a continuous series of the current cycles. 5 claims.

22,338. "Improvements in electric switches." Evered & Co., Limited, and S. Evered. Dated November 8th, 1899. Relates to a two-way switch rocked by a tumbler lever. A U or V-shaped contact lever is pivoted on a pin, and is adapted to connect the terminals. The tumbler lever is fitted with a sliding insulating sleeve passing between the contact arms and working in a recess in the base. A spring gives a fly motion. 2 claims.

22,387. "Improvements in and relating to chemical electrical excitants." J. Post. Dated November 9th, 1899. An exciting liquid for use in batteries of ordinary construction consists of a mixture of equal parts of pulverised charcoal, glucose, hydrochloric acid and sucrose dissolved in 98 per cent. of water. 2 claims.

22,517. "Electrical influence machines." W. R. Pidgeon. Dated November 11th, 1899. In its simplest form the machine consists of three discs, closely covered with metallic sectors, embedded in insulating material, and provided with means such as crossed and open belts for rotating the two outer ones in one direction and the central one in the opposite direction. The outer discs may be similar to those described in Specification No. 15,100, A.D. 1898, but the central one has its exposed contacts placed near or upon the periphery. Earthing or neutralising brushes, as well as collecting brushes or knobs. Fixed inductors similar to those described in the prior specification, may be arranged outside the discs, each being kept charged by an exploring point. Any number of groups of three discs may be arranged on the same axis, each group being provided with earthing brushes, collectors, and inductors. By bringing two neighbouring sets near together, the same inductor may serve for the two adjacent discs. The discs may be driven by crossed and open belts, as in the simpler form, or by means of sun-and-planet gearing, or by means of two internal spindles geared together and to the outer and central discs respectively. Another form of driving gear consists of an arrangement of rolling collars carried by a set of six spindles arranged round a central spindle, the outer spindles gearing with each other and every alternate one with the central spindle. In another form of machine all the discs are placed close together on the same axis, and each is turned in the opposite direction to that of both its neighbours. Moreover, the discs may be built up of three thin sheets of glass, ebonite, "volenite," or other insulating material, having the sectors arranged on alternate sides of the central sheet. The sheets of ebonite or "volenite" may be welded together, and the ebonising process completed, after building up the plate. 12 claims.

22,525. "New or improved means for placing, removing and cleaning incandescent electric lamps." H. J. Haddan. (E. E. Simms.) Dated November 11th, 1899. Incandescent lamps are put up, taken down, or cleaned without removal from their holders by the appliance shown, carried on a pole. Four springs, covered with india-rubber, or with felt rubbers, are carried by a head, on a hollow shaft, which is rotatable in a yoke by a pulley and cord. The cord passes through eyes and under retaining springs on the yoke. The yoke is made with a toothed disc to fit a similar disc on the end of the pole, so that the yoke may be fixed at any angle to the pole by a clamping screw. The springs may be opened by a bevelled plate, when this is placed on a screw-threaded part of a rod, which passes through the hollow shaft and is secured either in this shaft or in the yoke by set-screws. Corners of the bevelled plate engage the springs, so that if the rod is clamped in the yoke, and the pulley and springs are rotated, the plate unscrews and passes on to a reduced part of the rod, leaving the springs, which can thus be closed on a lamp. The springs may be pulled directly off a lamp. 19 claims.

22,533. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated November 11th, 1899. Relates to means for regulation in three-wire systems, and consists in arranging a generator or other source of electromotive force in the neutral or compensating wire. In the application of the invention to a system in which a three-phase current from a transformer is supplied to a rotary converter which supplies a direct current to the system, a generator suitably driven, is arranged between the middle wire and the neutral point of the transformer. A shunt with a resistance is connected across the field coil so that the field can be regulated as desired. 13 claims.

22,536. "Improvements in electric circuit changers." The British Thomson-Houston Company, Limited. (E. Oxley.) Dated November 11th, 1899. In apparatus having a liquid conductor, such as mercury, connecting the terminals, the circuit is broken by interposing a non-conducting diaphragm between them. In the form described in the specification a terminal dips into a body of mercury. A shell, or hood, is mounted on a shaft, and when turned completely insulates the terminal. The shell is counterbalanced so as to be easily operated by electro-magnets. 5 claims.